POWER TOPICS CROSS-INDEX

STEAM GENERATION
POWER GENERATION
WATER POWER
DIESEL & GAS ENGINES
AIR CONDITIONING & HEATING
REFRIGERATION
PUMPS & COMPRESSORS
STEAM SERVICES
ELECTRICITY & ELEVATORS
INSTRUMENTS & CONTROL
PIPING SYSTEMS
MECHANICAL TRANSMISSION
POWER MISCELLANY

VOLUME 83 NUMBER 5

POWER

N. O. WYNKOOP, *Publisher*
PHILIP W. SWAIN, *Editor*

Associate Editors
F. A. ANNETT
S. A. TUCKER
E. J. TANGERMAN, *Consulting Editor*
Assistant Editors
B. E. SAWYER
L. N. ROWLEY

PAUL WOOTON, *Washington* G. C. TENNEY, *San Francisco* H. S. KNOWLTON, *Boston*

MAY, 1939

3840 hp from sludge-gas engines at Tallman's Island 58
How to choose types of wire rope for elevator service 62
Selecting auxiliary turbine drives for heat balance 64
June brings the cadets—breaking in on a new job 67
Good suction-pipe hookups mean fewer pump troubles 68
Test tags field-coil fault before disturbing winding 71
From slash pine to paper—power pays the way 73
- How power fits into the paper-making picture 74
- Balancing steam and power loads 75
- Selection and operation of power boilers 77
- Kraft-mill bark-burning practice 78
- "Black-liquor" and other recovery boilers 80
- Nine turbine-generator plants compared 82
- Distribution and application of power 83
- Meters, piping and buildings 84

Conveyor stokers—last of a series on firing equipment 85
How to select and apply industrial thermometers 88
Rebuilt 200-kw plant reduces coal consumption by 25% 90
Research shows that metals affect turbine-oil life 97
Report of annual Midwest Power Conference, Chicago 100

DEPARTMENTS

Speaking of Power 72
Engineers' Bookshelf 104
Practical Aids 110
New Plant Equipment 122
Readers' Problems 102
Power Lines 105
Data Sheet No. 82 120
George Edwards 128

Publication office: 99-129 North Broadway, Albany, N. Y.
Editorial & Executive Offices: 330 West 42nd St., New York, N. Y.

A McGRAW-HILL PUBLICATION

JAMES H. McGRAW, Founder and Honorary Chairman

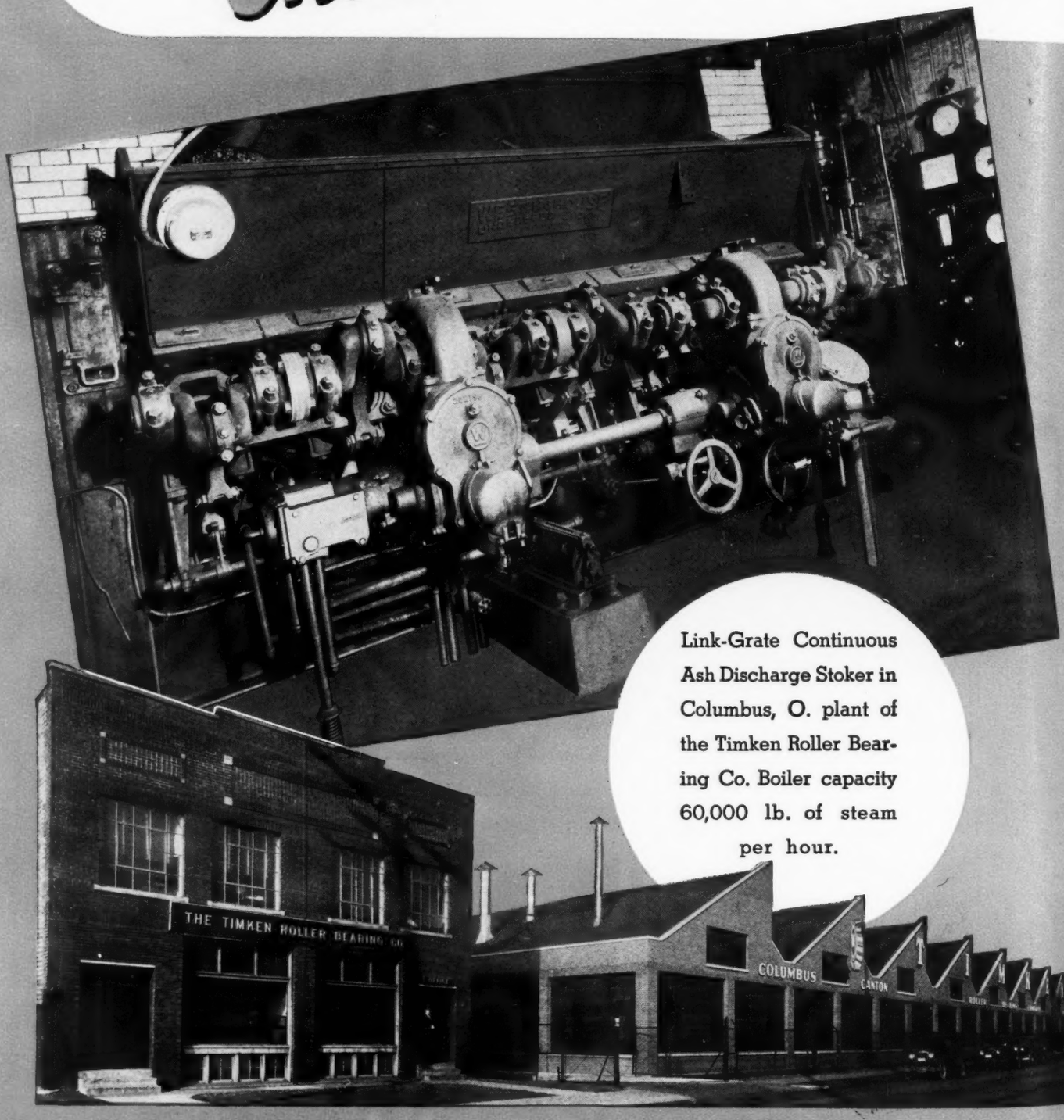
JAMES H. McGRAW, JR., President
HOWARD EHRLICH, Executive Vice-President
MASON BRITTON, Vice-Chairman
B. R. PUTNAM, Treasurer
D. C. McGRAW, Secretary
J. E. BLACKBURN, JR., Circulation Manager

CHICAGO, 520 North Michigan Ave.
SAN FRANCISCO, 883 Mission St.
WASHINGTON, National Press Bldg.
PHILADELPHIA, 16 South Broad St.
CLEVELAND, 1510 Hanna Bldg.
DETROIT, 2-144 General Motors Bldg.
ST. LOUIS, 455 Paul Brown Bldg.
BOSTON, 1427 Statler Bldg.
ATLANTA, 1105 Rhodes Haverty Bldg.
LONDON, Aldwych House, Aldwych, London, W C.2

Copyright, 1939, by McGraw-Hill Publishing Company, Inc.

POWER articles are currently indexed in both the Industrial Arts and the Engineering Indexes, available at public libraries. Also every year POWER issues an annual index of its own. Cable Address: "McGraw-Hill, N. Y."

Link-Grate STOKERS



Link-Grate Continuous Ash Discharge Stoker in Columbus, O. plant of the Timken Roller Bearing Co. Boiler capacity 60,000 lb. of steam per hour.

Westinghouse

POWER

Established 1882 PHILIP W SWAIN, Editor

A Penny Saved

Canny old Ben Franklin once said, "A penny saved is a penny earned." Nowhere is that old saying more true than in the power plant, where engineers whittle away persistently to recapture the burnable heat units now escaping to air or sewer. They've installed economizers, preheaters, superheaters, reheaters, waste-heat boilers, and dozens of other more-or-less familiar devices to win back vagrant Btu's. They've been after the thousands of others wasted outside the power house, too—in the black liquor, bagasse, hog fuel, leather scraps, blast-furnace gas, and so on that industry once threw away. Rejuvenation of the Southern paper industry from just such a development is reported in detail later in this issue.

There's progress to be reported in another direction also, progress that will save thousands of dollars every year for cities all over the country. Increasing understanding of the need for municipal sanitation, and resulting agitation against stream pollution by urban sewage, is forcing city after city to build expensive disposal plants. But the Btu hunter has come to the rescue here too. Some 65 of these new plants are providing their own power for disposal, wringing the consumable Btu's from the sewage itself.

The first of these plants was installed at Springfield, Ill., only seven years ago. In 1936 we reported some thirteen sludge-gas engines installed in twelve plants during the preceding two years. In 1938 we reported eleven engines in eight more plants. This year we'll report as many more again, installed since April, 1938.

Newest and largest of these plants in America is Tallman's Island, second New York gas-engine disposal plant, with 3840 hp. It is described beginning on the next page. But it really is only the beginning.

New York's present plans, to cite but one example, call for a 10-year program leading toward an adequate system of sewage-disposal plants, most of them gas-engine-driven. An extension to Coney Island plant is on the drawing board, as are new plants at Jamaica and Bowery Bay.

Dozens of other communities are making inquiries and planning adequate sludge-gas-engine-powered disposal plants. To the nation's present 35,000 hp will soon be added some 10,000 hp more.

All in all, it looks like the Btu-recoverers have brought the dawn of a new day for both the gas engine and the Southern paper industry. They can save dollars for any community or any industrial plant with a waste-disposal problem, provided only that the waste contains recoverable Btu's. By saving the pennies that once went out the sewer, cities and industries the country over are learning the truth of Franklin's doctrine. They're saving the pennies, knowing that then the dollars will take care of themselves.

Sludge and City Gas Give New York 3840 Hp

Tallman's Island, third step in New York's sewage-treatment program, combines gas engines geared to pumps and blowers with electrically driven auxiliaries

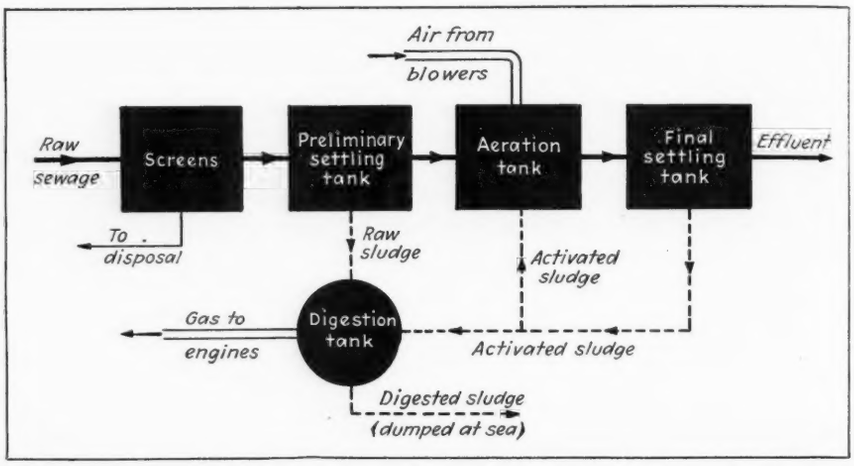


Fig. 1—Schematic diagram of activated-sludge process used at Tallman's Island

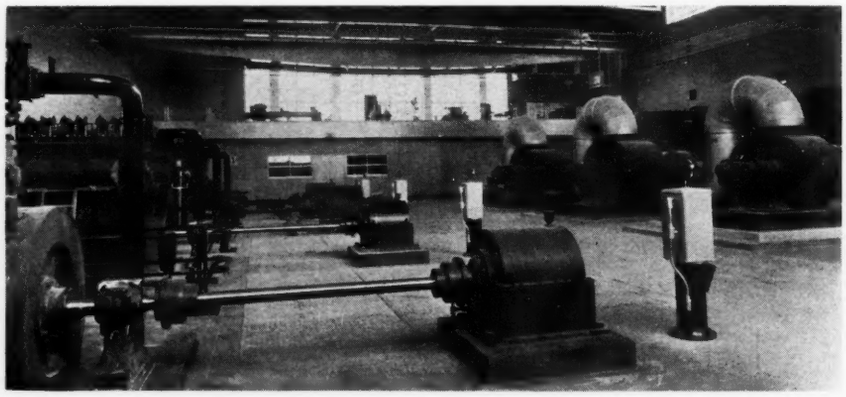


Fig. 2—Engines on left drive pumps in basement through right-angle gears, those on right are geared directly to blowers. Switchboard room at far end

LATEST AND LARGEST addition to the rapidly swelling ranks of sewage-treatment works generating power from sludge gas is the Tallman's Island plant in New York City, housing 3840 hp in gas engines driving sewage pumps and blowers. Manufactured gas serves as auxiliary fuel and purchased electrical energy supplies small motors and lighting. Capable of pumping 100 mgd of raw sewage under storm conditions, and designed to treat 40 mgd, this plant is the third major step in New York's program of sewage-treatment development, following the recently completed Coney Island and Ward's Island plants and to be followed by works at Bowery Bay, Coney Island extension, Jamaica, and 26th Ward.

Tallman's Island is an activated-sludge plant. Since method of treatment affects power requirements and amount of gas available for power generation, let's review briefly. Raw sewage contains more than 99% water, carrying both organic and inorganic solids. Solids are found in the solution, in colloidal form, and in suspension.

Screening removes large particles and settling separates smaller solids and sandy grit. These steps are common to most sewage-treatment plants; differences in treatment methods begin when attempts are made to settle colloidal solids and treat solids in solution.

In activated-sludge plants, major treatment takes place in aeration tanks. Bubbling air through sewage causes some coagulation of solids and greasy materials, but if aeration goes on in the presence of previously aerated sludge, the action proceeds rapidly and to completion. Thus the process consists of pumping sewage and a controlled amount of aerated or activated sludge into an aeration tank where the mixture is exposed to oxygen in air bubbled through it while the mass is being agitated. The exact mechanism of this operation is not definitely known, but apparently bacteria in the aerated sludge assimilate organic matter of the sewage, changing colloidal and dissolved solids in such a way that they can be settled out.

Final settling takes place in separate tanks. The effluent, when chlorinated, is virtually pure water. A portion of the sludge from the final settling tanks goes back to the aeration tank to maintain action there, the remainder proceeds to the digestion tanks. Additional sludge comes to the digestion tanks from the preliminary settling tanks. Fig. 1 indicates the broad outlines of the process.

Digestion is only one way of handling sludge; it may be treated with chemicals, dried on beds or in kilns, dumped at sea, incinerated, or processed into fertilizer. Digestion offers these advantages: (1) it breaks down organic matter to produce a stable and inoffensive sludge, (2) it reduces bulk of sludge to be handled for final disposal, and (3) it produces gases hav-

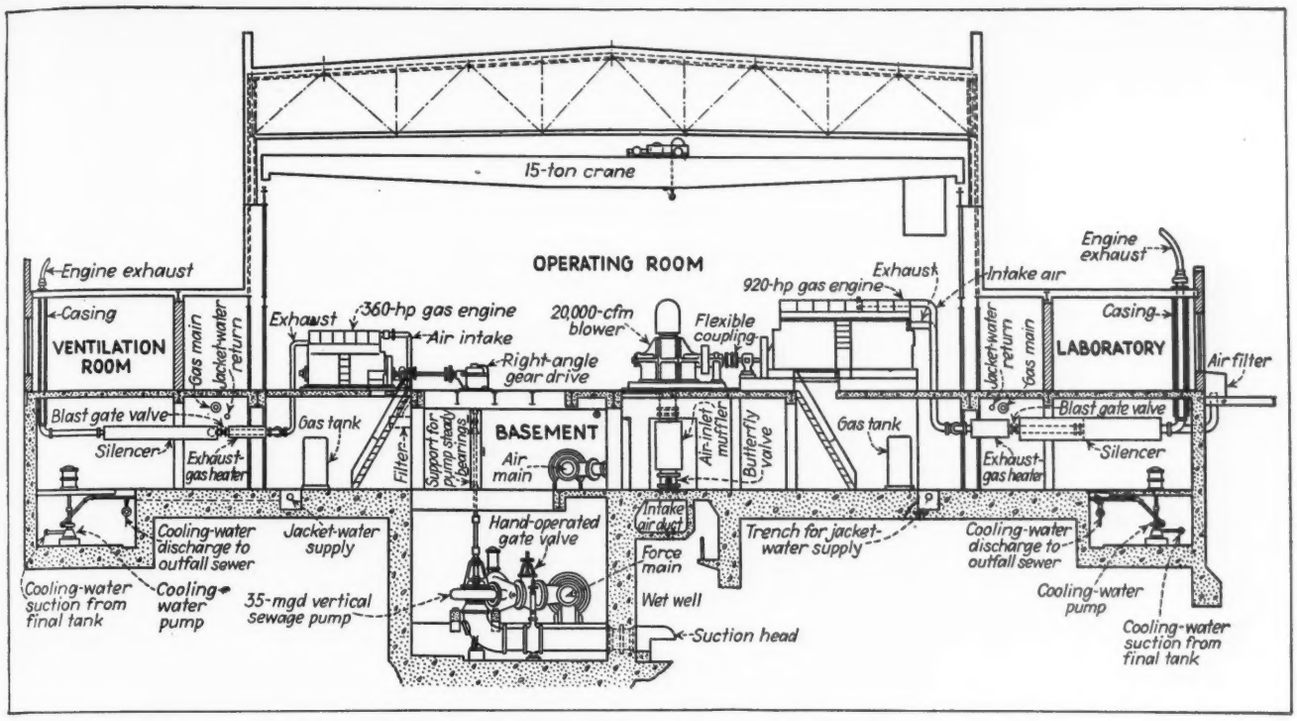


Fig. 3—Cross-section of engine room and basement

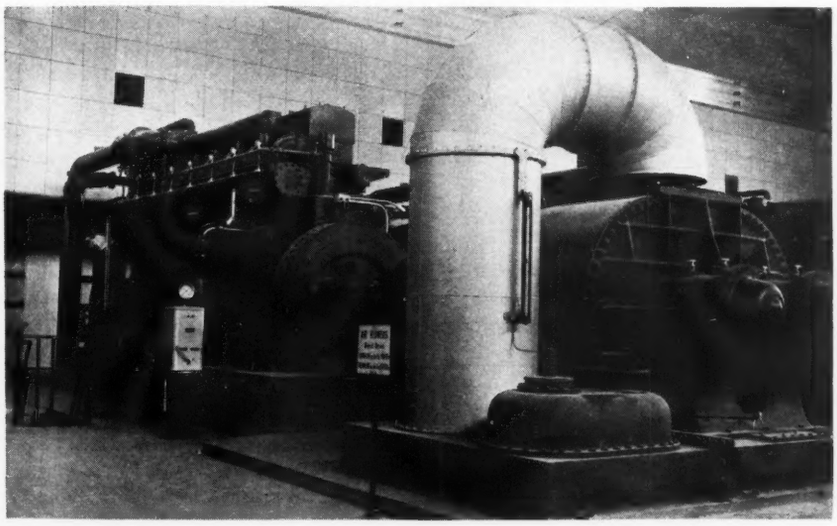


Fig. 4—16x20 in., 8-cyl, 300-rpm, 920-hp sludge-gas engine drives 20,000-cfm positive-displacement blower supplying air for aeration

ing value as fuel. Temperature influences rate of digestion; best condition is around 85—90 F. Even at best temperature, digestion is a slow process, requiring a month or more for completion. At Tallman's Island, digested sludge will be loaded into specially built diesel-powered boats and dumped at sea.

Gas evolved by digestion is largely methane (about 60–70%) with carbon dioxide (about 20–30%) as the next most important constituent. Hydrogen, nitrogen, oxygen, and carbon monoxide also appear in small quantities. Amount of hydrogen sulphide (H_2S) present is important; more than a trace will cause pitting of engine parts and where an appreciable percentage occurs, scrubbing equipment may be required. Heating value of sewage-sludge gas varies with character of sewage, ranging from 600 to 700 Btu per cu ft.

To sum up: sewage-treatment plants require power for pumping, for miscellaneous equipment such as revolving screens, agitators, skimmers, air compressors and other auxiliaries, and in large quantities for blowers if aeration is used. Gas evolved from digestion, if supplied to gas engines, will meet virtually all power requirements in plants depending on sedimentation or chemical treatment of sewage, but will fall short of meeting load in aeration or activated-sludge plants.

Power layout depends on extent to which sludge-gas power meets load conditions, on degree of variation in production of gas, and on relative cost of means of producing supplementary power. For obvious practical reasons, small equipment scattered about the usual extensive treatment works must be motor driven. Large pumps and blowers can be concentrated in one spot and driven by gas engines or electric motors.

Typical Layouts

Typical layouts include all-electric operation with gas engines driving generators, and combination of electrically driven auxiliaries with gas engines driving large pumps and blowers. In either layout, sludge-gas power may be supplemented by purchased electrical energy, by purchased gas, or by a combination of both, depending on relative costs.

Conditions at Tallman's Island dictated choice of a layout combining engine-driven sewage pumps and blowers and motor-driven auxiliary equipment. Manufactured gas supplements sludge-gas supply to engines. Direct drive on pumps and blowers reduces investment and virtually eliminates transmission losses. Control of engine speed gives flexibility for operating pumps and blowers at partial loads. Power generated from manufactured gas would not have been as economical as purchased electrical energy if it had not been possible to recover a large proportion of heat from engine jackets

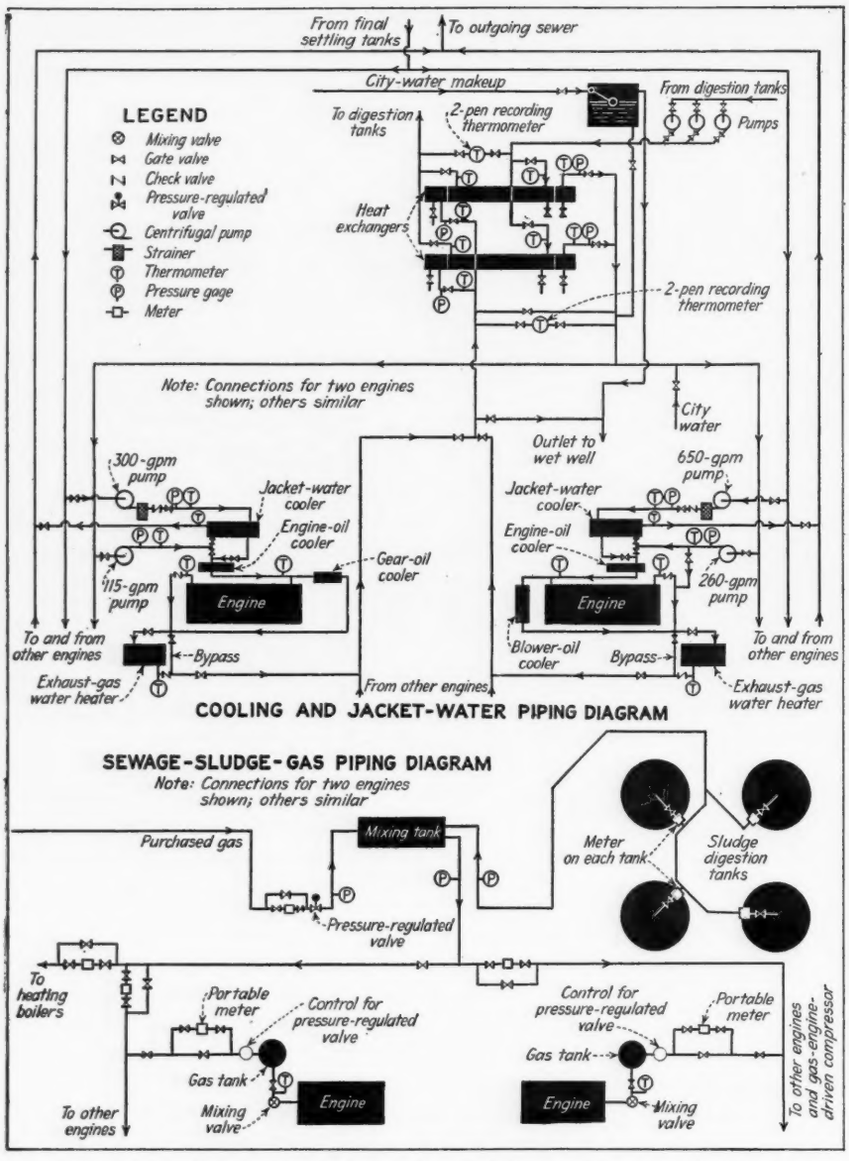


Fig. 5—Piping diagrams for jacket cooling and heat recovery, and fuel handling

and exhaust. Taking this into account, gas proved most economical at Tallman's Island.

The general view of the engine room, Fig. 2, and the cross-section, Fig. 3, show the general arrangement of engines and driven equipment. On the right-hand side, four engines drive blowers; on the left, four engines drive sewage pumps in the basement. Each set of engines is divided into two sizes for flexibility in meeting loads.)

At the far end, two 16x20-in., 8-cyl, 300-rpm, 920-hp Worthington heavy-duty sewage-sludge-gas engines drive, through flexible couplings, 20,000-cfm Roots-Connersville positive-displacement blowers which supply air for aeration. Adjoining these units are two 16x20-in., 4-cyl, 327-rpm, 460-hp machines connected to 10,000-cfm blowers.

Similarly, larger pumping units are located at the far end on the left side. Two 12¼x14½-in., 6-cyl, 400-rpm, 360-hp engines drive, through flexible couplings and right-angle gears, 35-mgd Worthington vertical sewage pumps of single-suction, non-clogging, volute type. Smaller units comprise two 12¼x14½-in., 3-cyl, 400-rpm, 180-hp engines, couplings and gears, and 15-mgd pumps.

All engines are typical heavy-duty sludge-gas units, fully-enclosed, with force-feed lubrication, removable cylinder liners, and separate cylinder heads. Pistons on 16x20's are oil cooled. Bolting water-cooled exhaust manifold to engine sides takes weight from cylinder heads; water-cooled elbows connect manifolds to heads. A cast-in lube-oil duct in the base with connections to bottom of each bearing allows removal of shell without breaking pipe connections. Joints between cylinder head and liner and between valve casing and cylinder head are metal-to-metal. Both valve casings and spark-plug assemblies can be removed as units. Dual ignition increases operating reliability; a 12-volt system, with high-tension coils adjacent to each set of spark plugs, is employed. The cam shaft actuates and times air-starting valves on each cylinder.

The diagram, Fig. 5, shows cooling-water circuits and how heat is recovered for maintaining desired temperature in digestion tanks. Apparent complication of circuits and controls arises from need for close temperature regulation at both engine jackets and digestion tanks. Keeping jacket-water temperature relatively high, with a narrow range between intake and outlet, avoids condensation of H_2S in the crankcase, with consequent formation of corrosive

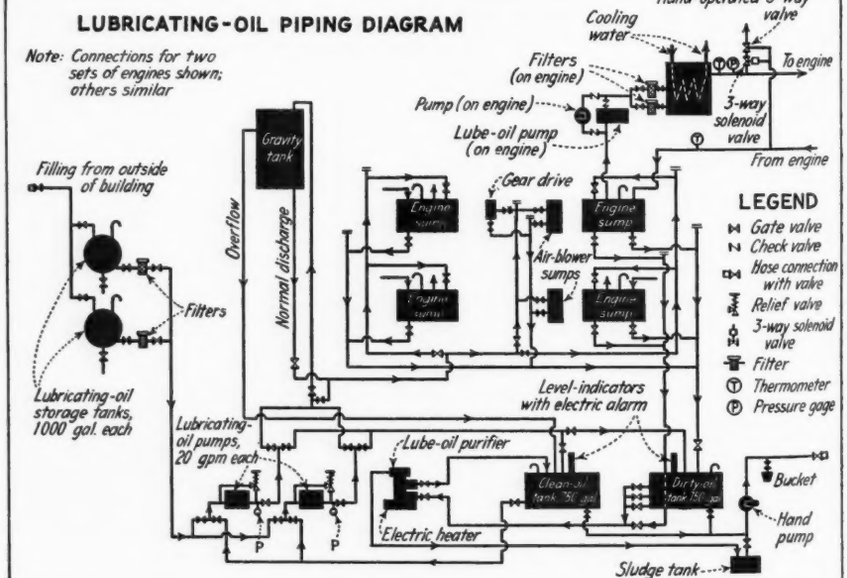


Fig. 6—Lubricating-oil-system diagram

acids. Keeping digestion tanks at optimum temperature speeds the process and gives maximum yield of gas.

Water leaving lubricating-oil coolers and engine jackets flows to a Foster Wheeler exhaust-gas water heater; the bypass provides temperature regulation. Heated water then flows to a pair of heat exchangers for transfer of heat to water circulating through digestion-tank coils. City water for makeup enters the return circuit under control of a float valve in the surge tank.

Looking at the circuit for the engine jackets and the lube-oil coolers, the flexibility of the arrangement can be seen. In cool weather, when digestion tanks must be heated, return water from the digester heat exchangers flows directly through engine-oil cooler and then through blower-oil cooler and engine jackets which are connected in parallel. In hot weather, when digestion tanks need not be heated, return water flows through the jacket-water cooler where it gives up heat to cooling water. Effluent from the final settling tanks does the cooling, then flows to grit washers or overboard to outgoing sewer. The bypass around the engine jackets and lube-oil coolers takes care of excess water from the constant-speed pump when low load on engine decreases circulation requirements.

Fuel Piping

The diagram at the bottom of Fig. 5 shows fuel piping. Sludge gas, collected under domes on digestion tanks, flows to a mixing tank, where it blends with purchased gas, which enters under control of a pressure-regulated valve. This valve operates when pressure registered by regulators at entrance to engine tanks falls below a set minimum. Mixing valves are designed to handle fuel ranging from the 540-Btu manufactured gas to 700-Btu sludge gas.

Flow from each digestion tank is metered, as is purchased gas. Additional meters record flow to each of main uses: gas to blower engines, gas to pumping engines, and gas to boilers for building heating. Connections for portable meters in supply lines to each engine will facilitate testing.

Fig. 6 shows the piping and equipment for handling, cleaning, and circulating lubricating oil for engines, blowers, and gears. Two 1000-gal. tanks, filled from outside the building, constitute main oil storage. The two 20-gpm transfer pumps take suction from either storage tanks or clean-oil tank and can pump to gravity tank, clean-oil tank, or dirty-oil tank. The gravity tank supplies engine and blower sumps, and gears, with an overflow to the clean-oil tank. Typical connections for the oil-circulating system on the engines are shown in the detail at the upper right corner of the diagram. Oil pumps on each engine handle flow through filters and coolers, and back to sump.

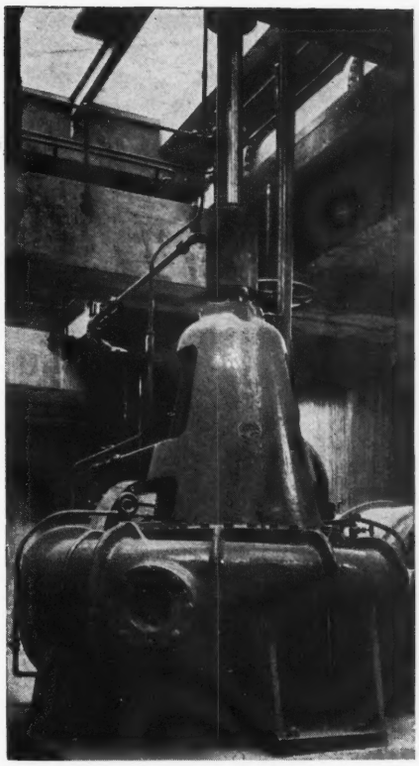


Fig. 7—Vertical sewage pump, 35 mgd

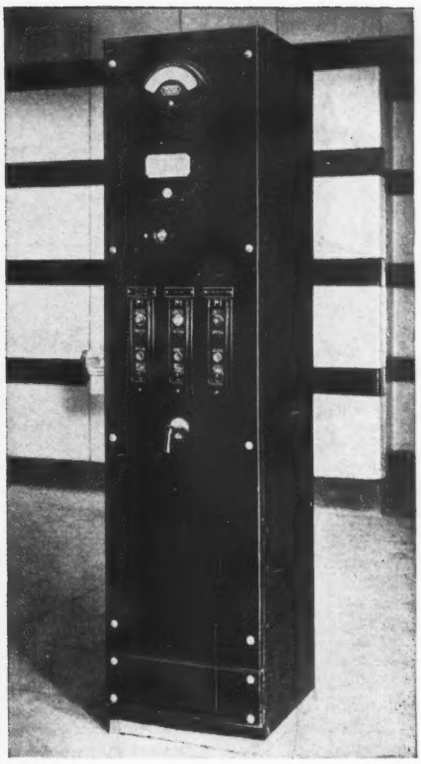


Fig. 8—Panel board for a 460-hp engine

Purification is a batch operation; normal procedure, with engine out of service, involves dumping oil from sump to dirty-oil tank and refilling sump from gravity tank. An emergency connection provides for flow of oil direct from engine sump to purifier. After purification in the Goulds Hydroil unit, oil returns to clean-oil tank, from which it can be pumped to gravity tank for eventual supply to sumps. Sludge from the purifier goes to a sludge tank from which it can be hand-pumped to a disposal connection. The same hand pump can be used to remove sludge from clean- and dirty-oil tanks.

Air for the four blower engines enters through filters outside the building. These are American units with dry, replaceable panels. Air supply for the pumping engines comes from the building basement; location of filters can be seen in the cross-section, Fig. 3. Each engine exhaust is equipped with a Maxim silencer. A gas bypass around the exhaust-gas water heaters protects against operation without water.

A panel board behind each engine mounts control equipment and instruments. In the typical board illustrated, Fig. 8, the lever at the bottom provides remote engine-speed control, while pushbuttons and signal lights control and show operation of circulating-water pump, oil pump, and cooling-water pump. The Alnor pyrometer measures temperature in exhaust of individual cylinders; turning the knob permits selection of cylinder. At the top is a Weston tachometer.

All equipment aside from the four blowers and four sewage pumps, and one gas-engine-driven air compressor for emergency service, is motor driven. Power-company services feed the main switchboard under the gallery. Cubicle-type board houses breakers and controls for distribution feeders within the plant; motor starters and controls are located as operating convenience dictates. In the switchboard room, motor-generator sets provide dc for control circuits; they are backed up by a rack of storage batteries.

The building housing the mechanical equipment is of buff brick in simple modern style. Large light-green tiles line engine-room walls. Gray terrazzo floor and satin-finish stainless-steel doors, column enclosures, and trim add to the attractive appearance. A complete machine shop occupies the balcony above the switchboard room.

The entire project was designed and executed by the Department of Public Works of the City of New York, Richard H Gould, Deputy Commissioner.

Which Wire Rope for Elevators?

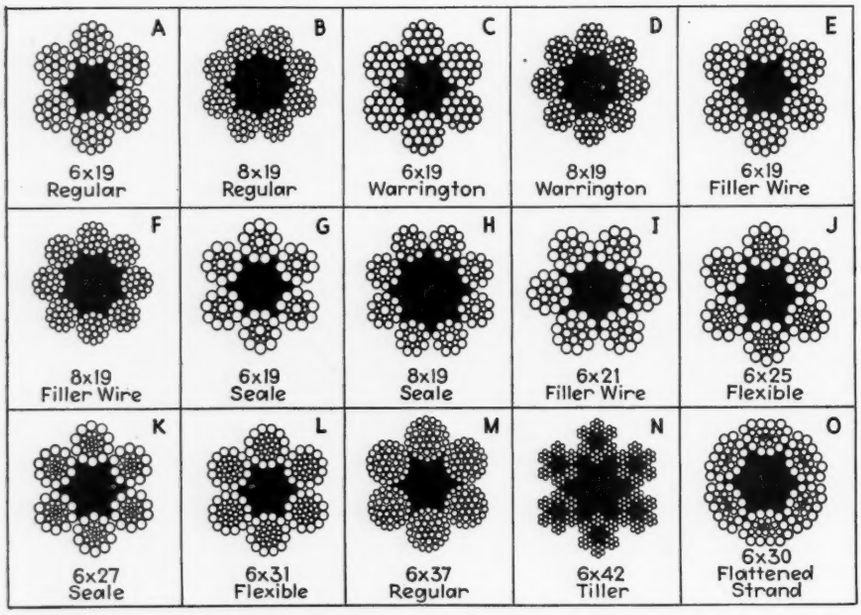


Fig. 1—Some types of wire-rope constructions, most of which are used for elevator service, showing strands laid around a hemp or other fibrous core

To find the answer, you will want to know the information in this article—various materials used in elevator wire rope, different constructions, and suggested services for which each type is suited

REPLACEMENT of wire ropes is one of the largest single items of cost in elevator maintenance. Not only does proper operation of elevators depend upon wire rope, but also their safety. Therefore, an understanding of wire-rope constructions and the factors that affect rope life is indispensable to every one responsible for elevator operation.

Back in the days when elevators operated at slow speeds and served comparatively few floors, selection of ropes was simple. Service conditions for the most part were easy and ropes usually lasted a long time.

Modern high-speed elevators have placed severe demands upon ropes. Speeds are high; many present-day cars travel more miles in a month than some of the old elevators did in 10 years. Acceleration and retardation rates are high. Friction between the ropes and traction-sheave grooves is depended upon to hoist and lower the car, which means that there is always some slippage between grooves and ropes. With multiple-rope drives, such as on traction machines, it is difficult to maintain equal loading on the individual ropes.

To meet today's conditions, a wide variety of wire ropes have been developed. These ropes must be hard enough to withstand abrasion, but not sufficiently hard to damage the sheave grooves during normal operation. They must also be tough enough to prevent rapid fatigue from continuous bending around the sheaves.

Materials used in elevator ropes are usually iron or steel, several high grades having been developed for this service. For example, hoist ropes on traction-type elevators are usually made of traction-steel. This is a form of toughened mild steel with a tensile strength of about 150,000 to 170,000 lb per sq in. Where atmospheric conditions are very bad, because of moisture and acid fumes, monel-metal ropes have been used. For the tail rope from governor-rope connection on the car to the car safety drum, phosphor bronze is sometimes used.

Wire ropes for elevator service are made in many constructions, several of which are shown in Fig. 1. All elevator rope is made up of 6 or 8 strands laid up around a hemp or other fibrous-material core. A common strand construction is a layer of 6 wires about a central wire, see Fig. 2. About the layer of 6 wires is placed a layer of 12 wires, making a total of 19 in the strand. Six or eight of the strands are laid up about a hemp core to form what is known as a 6x19 construction, Fig. 1*A*, or an 8x19 construction, Fig. 1*B*.

Where very flexible rope is required, 37-, 61- or 91-wire strands are used. These are made by placing a layer of 18 wires over the 19-wire strand to obtain 37 wires, a layer of 24 wires over the 37 wires to give a total of 61 wires and a layer of 30 wires over the 61 to make a 91-wire strand, Fig. 2.

The larger the number of wires in a given size strand, the smaller the size of the individual wires. Except for tiller rope, strands having more than 25 wires are not generally used for elevator service because the outer wires are too small to stand abrasion and mechanical stresses of contact with the sheaves. Many constructions have been developed that combine small center wires with large outside wires to obtain a rope that has high flexibility and high resistance to wear and mechanical stresses.

Constructions

In the regular constructions *A* and *B*, Fig. 1, each strand has 19 wires, all practically the same size. The Warrington constructions *C* and *D* have three sizes of wires in each strand. The 7 center wires are approximately the same size and are surrounded by 12 wires that are alternately large and small.

Constructions *A* to *D* at one time were used extensively for elevator service, but have now been superseded to a great extent by constructions *E* to *J*. *E* and *F* are practically the same as *A* and *B*, except that the former have 6 fine wires, known as filler wires, in the spaces between the outer and inner layers of large wires.

The 6x19 and 8x19 Seale, *G* and *H*,

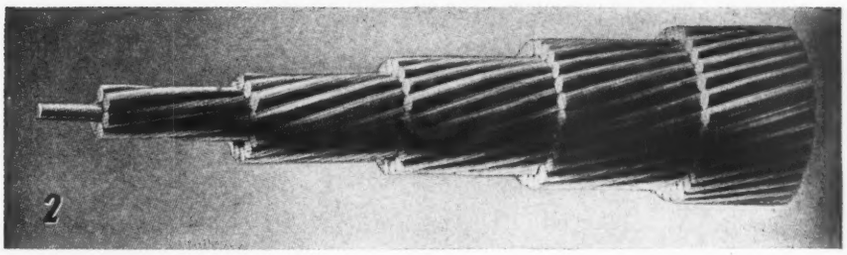
constructions are among the most popular for hoist ropes. Strands in these constructions have one large center wire surrounded by 9 small ones around which are 9 large ones. This places the largest wires on the outside where they are subjected to wear.

The 6x21 filler construction has four different-size wires in it. About a small center wire are placed 5 larger wires over which are placed 10 still larger ones, with 5 filler wires in the spaces between wires in the outer and inner layers.

Where a more flexible construction is required than the 6x21 filler construction, the 6x25 or 6x27 designs are used. These have an outer layer of 10 large wires and an inner layer of 10 smaller wires inside of which are 5 or 7 small wires. The 6x31 construction is a flexible design sometimes used for governor ropes, but the 6x37 regular is seldom used because its wires are too small to stand the service. Other designs of this construction have been developed for specific purposes, mostly outside the elevator field.

On hand-rope-operated elevators, 6x42 tiller construction is almost universally used for the operating rope. Each strand of this rope is really a 6x7 rope made up of 6 strands of 7 wires each laid around a hemp center. Six strands of 42 wires each are then laid up around a large hemp center to obtain a 6x42 assembly.

The flattened-strand rope has been shown principally to indicate an interesting construction, as it is now used outside the elevator field.



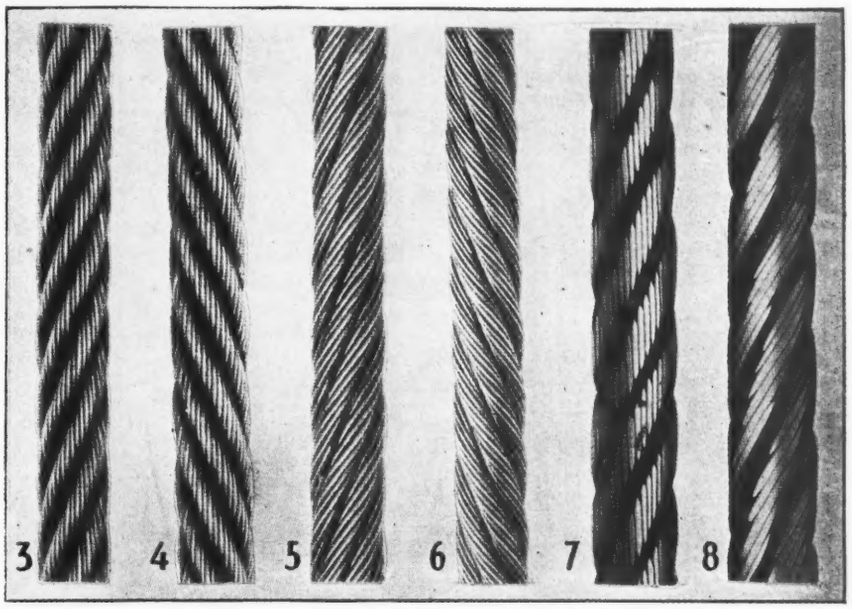


Fig. 2—The various steps in building up a rope strand of 7, 19, 31, 61 and 91 wires. Fig. 3—Right-lay, regular-lay rope. Fig. 4—Left-lay, regular-lay rope. Fig. 5—Right-lay, Lang-lay rope. Fig. 6—Left-lay, Lang-lay rope. Fig. 7—Worn regular-lay rope. Fig. 8—Worn Lang-lay rope

Preformed—Non-Preformed

Wire-rope constructions may be divided into two general classifications: preformed and non-preformed. In the non-preformed, wires are laid into the strands and the strands into the rope without any forming other than that of laying the wires and strands into place. Ropes of this construction must always be securely seized with wire at the ends when cut or they will unlay because of the spring in the wires.

In preformed rope, wires in the strands and the strands making up the rope are formed to the shape they take in the rope before being laid into place. This is done so exactly that a strand may be removed from a short section of rope and a wire taken from the strand, after which both can be returned to their original position.

Both types of ropes are used in elevator service. Several rope manufacturers supply preformed rope as their first preference. Other manufacturers recommend non-preformed rope, but will supply preformed on request from the purchaser.

The direction of laying the wires in the strands and the strands in the rope is the final element in rope construction required to complete the picture. As shown in Figs. 3 to 6, there are 4 different lays. In the regular lay, Figs. 3 and 4, wires in the strands are twisted in an opposite direction to the rope lay. The strands may be placed in what is known as a right lay, Fig. 3, or a left lay, Fig. 4. In the right lay, the strands take the form of a long-pitch right-hand thread on a bolt. Left lay, Fig. 4, is just the reverse of right lay and takes the form of a long-pitch left-hand thread.

Lang-lay rope, Figs. 5 and 6, has wires in the strands twisted in the same direction as the rope lay. This construction may be either right lay, Fig. 5, or left lay, Fig. 6, as with the regular lay. In the regular lay, wires on the outside surface of the rope run almost parallel with the axis of the rope, but in the Lang-lay they are at an angle.

Lang-lay rope is more difficult to handle than regular lay, as it has greater tendency to unstrand. It is also more easily kinked and bird-caged than regular-lay rope. For these reasons, Lang-lay rope has not been extensively used. As shown in Figs. 7 and 8, Lang-lay rope provides a greater area to wear than does a regular lay.

In general, right-lay regular-lay constructions are most commonly used. For some elevator and hoist applications, left-lay rope is used with right lay to obtain a non-rotating combination. This is, however, the exception.

Recommendations

Elevator-rope recommendations given by different rope manufacturers vary so widely and conditions under which the ropes are used involve so many variables, that no general recommendations can be made. The 6x19 and 8x19 constructions are the ones most generally used, but other constructions are also applied. Traction steel has found wide acceptance as material for overhead traction elevators; for compensating and governor ropes and ropes on drum elevators, traction-steel, cast-steel and iron may be employed. Rope manufacturers are in a position to provide expert advice on various applications and should be consulted about the type of rope best suited for a given application.

Selecting Turbine Drives for

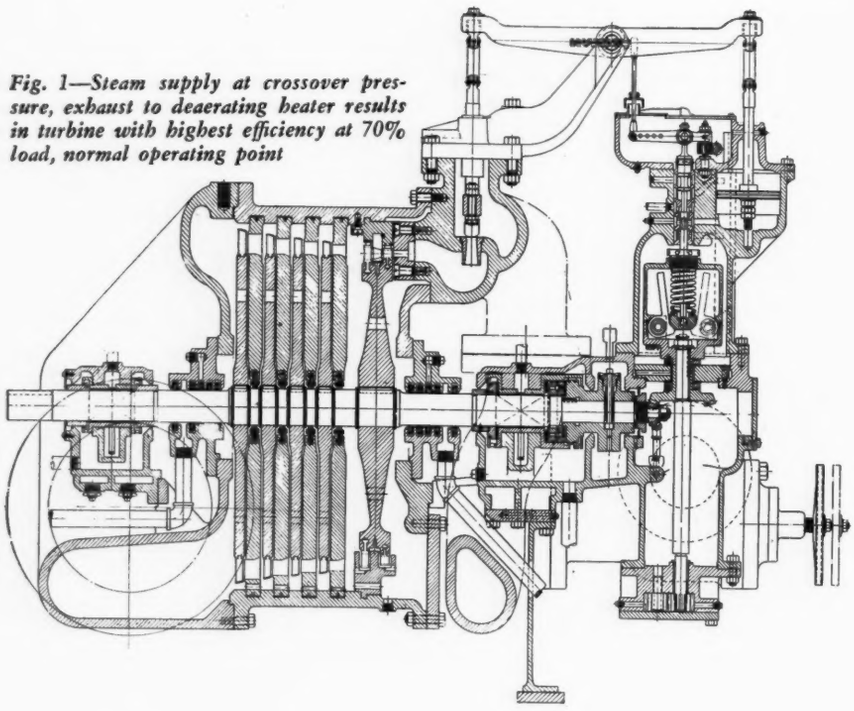


Fig. 1—Steam supply at crossover pressure, exhaust to deaerating heater results in turbine with highest efficiency at 70% load, normal operating point

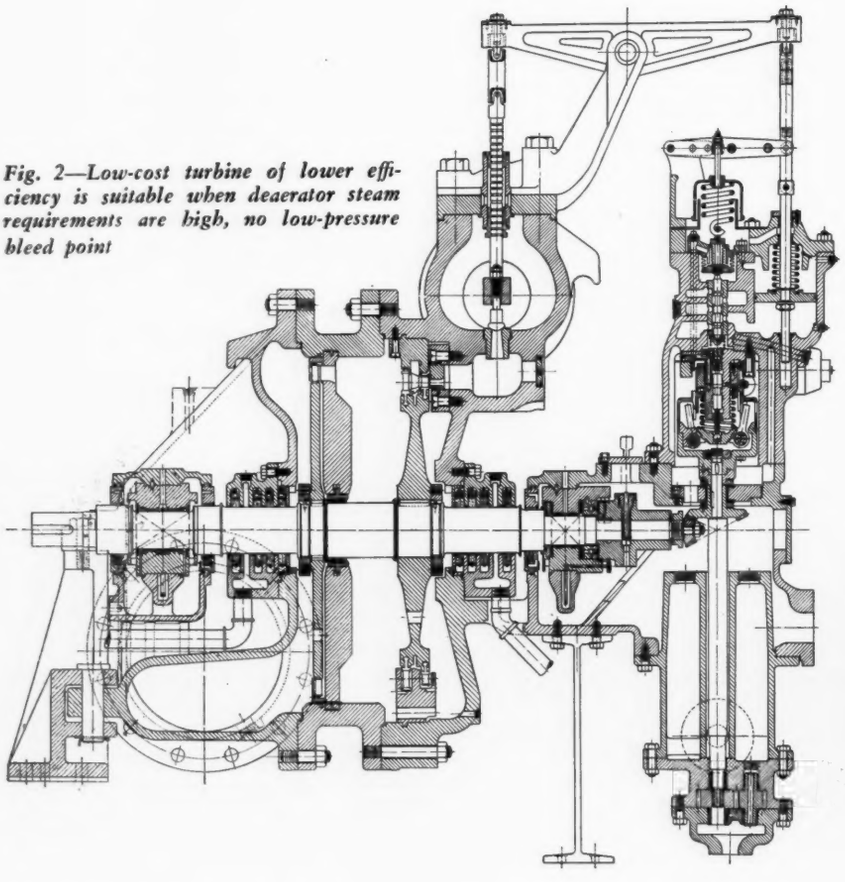


Fig. 2—Low-cost turbine of lower efficiency is suitable when deaerator steam requirements are high, no low-pressure bleed point

MODERN HIGH-PRESSURE plants require very much more auxiliary power than the relatively smaller, lower-pressure installations of the 1920's, particularly for boiler-feed pumping. Power requirements of boiler-feed pumps, which formerly rarely exceeded 300-500 hp have increased to 1500-2000 hp in new high-pressure plants. This situation, while not a serious deterrent to use of high pressures, requires careful consideration because auxiliary drives now have more influence on heat balance and operating economy.

Auxiliary-drive application must be considered in two classifications; namely, those used with complete new condensing installations and those for high-pressure superposed units which operate in conjunction with existing low-pressure condensing equipment.

Up to now, most problems have come up in revamping existing equipment centering around the superposition of high-pressure units. This will probably be carried on until all worthwhile low-pressure plants have been topped. Care must be exercised in selecting auxiliaries, since it usually is not possible to alter existing equipment to fit a desirable heat-balance layout; by proper choice of auxiliary drives, it is always possible to arrive at a satisfactory solution.

Only a small number of turbines installed previous to 1920 were designed to operate with extraction for feedwater heating. In general, heat-balance layouts of the older plants are arranged as follows: (a) condensate from the hotwell passes through a closed, subatmospheric heater supplied with steam from the low-pressure extraction point of the main unit, at a pressure of from 6 to 8 lb abs, (b) through a second

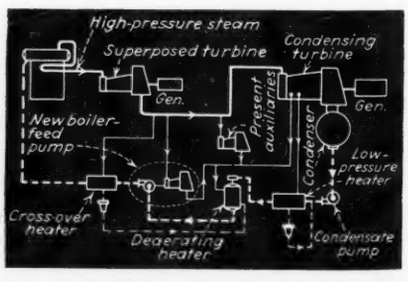


Fig. 1a—Hookup for typical application of turbine, Fig. 1

Heat Balance

High pressures demand more feed-pump power; topping brings up varied heat-balance problems. Result is a whole family of turbines for auxiliary drives

By C C FRANCK
Westinghouse Electric & Manufacturing Company
South Philadelphia, Pa.

heater, (c) through boiler-feed pump and into the boiler. The second heater is usually a deaerating heater maintained at a pressure from atmospheric to 5 lb, g.

This heater is sometimes supplied with steam from the high-pressure extraction point of the main unit, but in the majority of cases absorbs exhaust steam from station auxiliaries.

The advent of the superposition turbine, with exhaust going directly into existing headers of the low-pressure system, leaves the normal plant without possibility of a feedwater heater between deaerator and crossover. This difference in pressure is in itself not serious, however, since a large heater at the crossover point permits heating condensate from approximately 215 F to 380 F in one step.

The arrangement in the above case, when the deaerating heater can absorb auxiliary-drive steam, results in a comparatively simple type of mechanical-drive turbine for the boiler-feed pump, see Fig. 1. Steam is taken from the crossover or the exhaust of the main superposed unit at pressures from 200 lb to 250 lb and at an average enthalpy of 1300 Btu per lb. Steam is exhausted at 3 to 5 lb and steam flow is regulated by a multi-valve chest operating in response to a differential regulator connected into the boiler-feedwater supply.

Maximum rating for this unit is approximately 1200 hp, but it operates normally at 800 hp and consequently must have its point of best efficiency at 70% of rated load. This is obtained by crowding the stages at large flows and results in increased leaving losses at maximum load but improved efficiency at desired best point of operation. A typical heat-balance arrangement, Fig. 1a, utilizes a turbine as shown in Fig. 1.

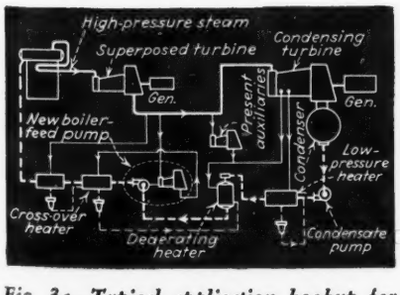


Fig. 3a—Typical application hookup for Fig. 3 turbine

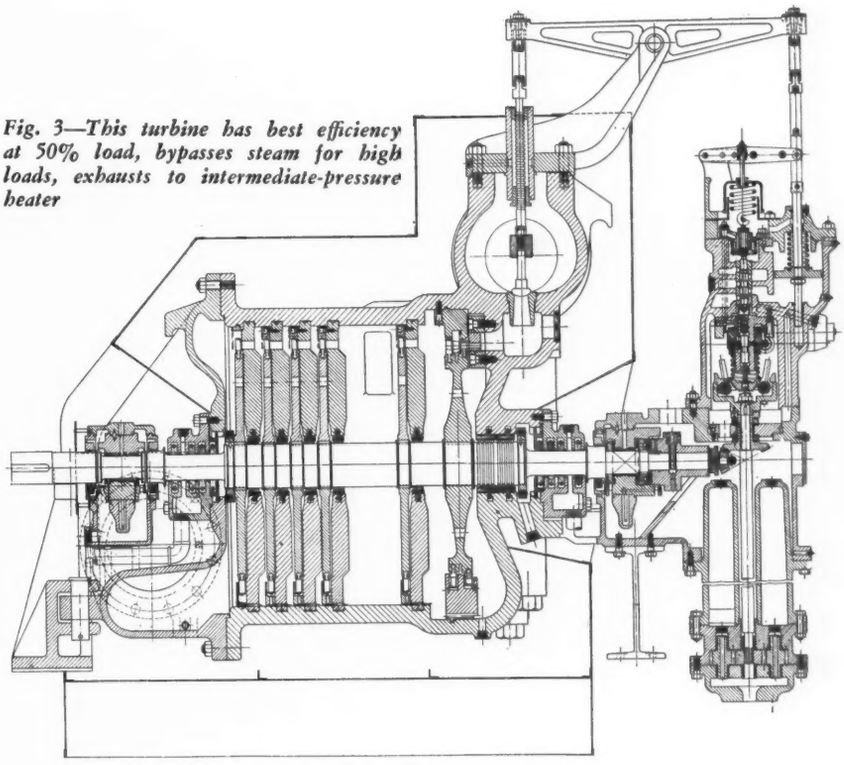


Fig. 3—This turbine has best efficiency at 50% load, bypasses steam for high loads, exhausts to intermediate-pressure heater

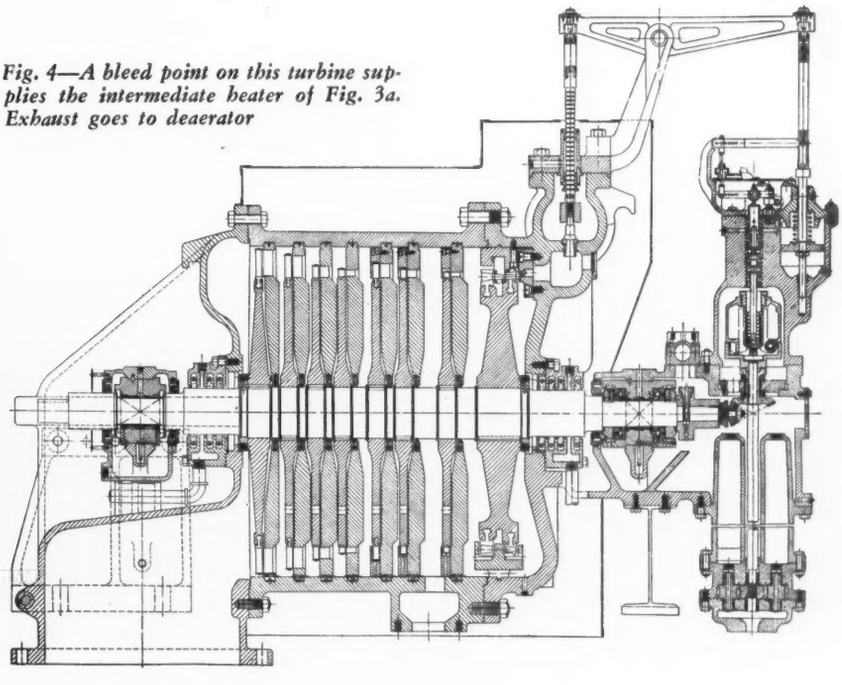


Fig. 4—A bleed point on this turbine supplies the intermediate heater of Fig. 3a. Exhaust goes to deaerator

Fig. 2 shows a turbine used where there is no high-pressure extraction point available in the existing low-pressure units. A situation of this sort naturally results in increased absorption capacity at the deaerating heater, and this deficiency can be made up with steam from the boiler-feed pump. Consequently, with boiler-feed-pump requirements and available energy substantially the same as in the previous case, an increase in flow is counterbalanced by a lower-cost turbine of lower efficiency. Fig. 3 represents such a turbine and Fig. 3a the typical heat-balance layout.

While this unit must carry 2000 hp under maximum conditions, it should have a very high efficiency at its normal operating load of 1000 hp. The magnitude of necessary stage crowding at high loads would reach a point where it would be impossible to pass enough steam through the unit to carry the required maximum load without application of by-passing. The necessary steam is admitted, under governor control, through the rectangular slot shown between the second and third stages. The resultant characteristic is that of high efficiency at light flows (i. e. partial loads) and ability to pass large quantities of steam when necessary.

The type shown in Fig. 4 is used with the system of Fig. 3a, with the exception that power requirements of the boiler-feed pump are such that the unit must extract steam for the intermediate heater and at the same time make up for the deficiency in power by exhausting steam into the deaerating heater. Steam is extracted non-automatically; extraction pressure varies with the flow through the last stages of blading. A unit of this type must be carefully fitted into the heat-balance system, since certain conditions of feedwater flow and power requirements may result in impossible operating conditions because of the uncontrolled extraction pressure. Maximum load also depends upon amount of steam extracted and the design of low-pressure stages relative to high-pressure stages.

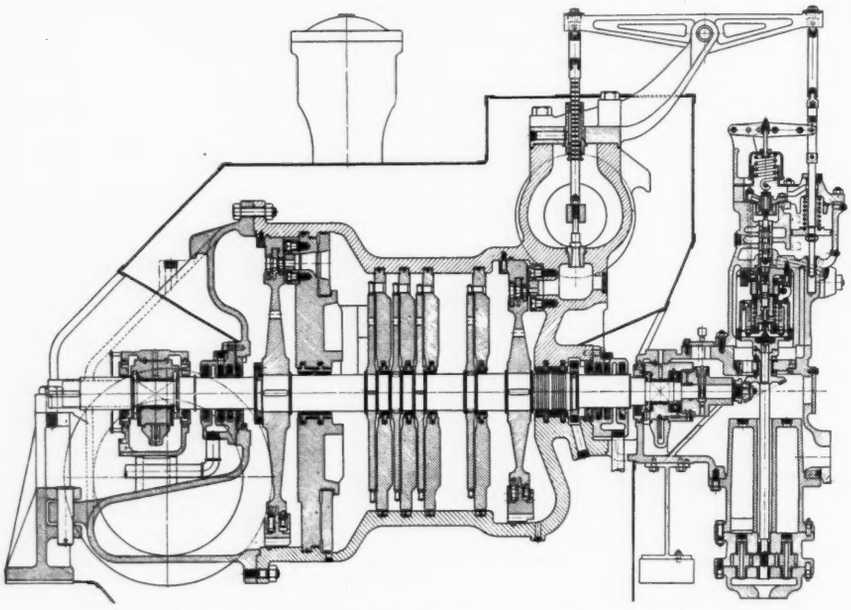


Fig. 5—Sliding grid valve controls bleed pressure for intermediate heater

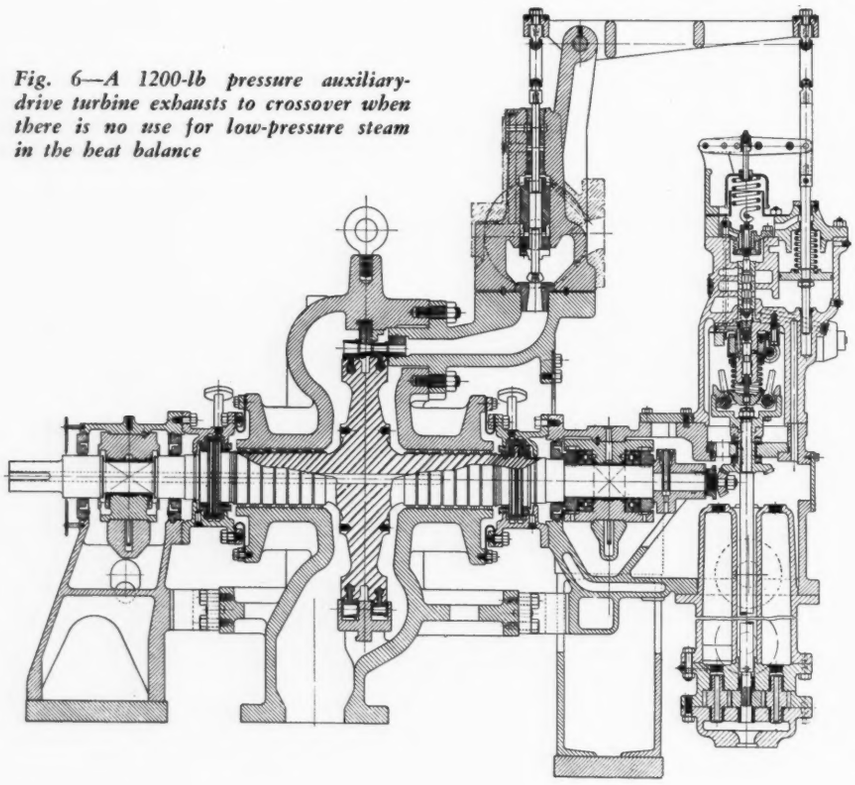


Fig. 6—A 1200-lb pressure auxiliary-drive turbine exhausts to crossover when there is no use for low-pressure steam in the heat balance

Automatic Extraction

The unit shown in Fig. 5 embodies the principles of the unit shown in Fig. 3, that is, high efficiency at light flows and the capability of passing high flows while extracting steam for the intermediate-pressure heater. However, it overcomes the obstacles of (1) load depending on the extracted steam quantity and (2) limitation of maximum load due to relative design characteristics of high- and low-pressure stages by use of an automatic-extraction feature. The latter provides for constant pressure at the intermediate heater and results in constant temperature rises in the heaters at all loads.

The automatic-extraction feature consists of a sliding grid valve which moves in response to pressure in the extraction zone, and maintains constant pressure regardless of flow through the low-pressure stage or the flow out through the extraction line. This turbine has all the flexible characteristics of two separate units with all the advantages of a single unit.

Fig. 6 represents a specialized case of boiler-feed-pump drive and fits into a system where there is no use for low-pressure exhaust steam.

This unit takes steam from high-pressure boilers at 1200 lb, 900 F, and exhausts directly into the low-pressure header system. Because of severe operating conditions, the design is rugged.

It is interesting to follow the trend and development of this class of machine and the advent of 2500-lb stations will probably present equally interesting problems in the future.

June Brings the Cadets

PUBLIC RELATIONS for POWER MEN

Here's some good-natured advice for college-trained apprentice engineers that applies equally well to all young men starting in on new jobs. The idea is to keep your shirt on and let actions speak for you

By R T ELLWOOD

ANOTHER JUNE will soon have come and gone, leaving behind another batch of several thousand lads packed full of thermo, hydro, electro and ego. They are this year's engineering graduates, many of whom will become cadet or apprentice engineers.

Employers have long realized the importance of teaching future salesmen what to sell, research men what to seek, and designers what to plan. Training courses systematize such instruction and simplify it.

You cadets are important to your firm, you are the future occupants of the drivers' seats; in other words, the spare parts being machined and polished to dovetail into the organization when older men retire, pass on, or the business warrants expansion. Most of you are aware of this feeling, which is in itself harmless enough, but why in blazes must you shout it from the desk tops. "Broadcasting" of that nature does no good and can do much harm; for remember that a reliable sign of an inferiority complex is a continual effort to make oneself noticed. Conversely, it is indicative of a fear of being overlooked. So don't be too anxious to attract attention; your output will be your press agent—and that works both ways.

You will probably start your course knowing at least twice as much as any other engineer with your outfit, and by the time you complete it, you will have advanced to the point where you know at least as much as the older men. A few years later, you may reach the stage where you wish you knew half as much as your more experienced associates and when this realization of your shortcomings strikes you, you become an asset to your employer.

College graduates come out of school crammed full of scientific and engineering knowledge some of which, such as the ability to perform a simple addition, may be useful in the raw state. However, most of it must be tempered and modified by the practical and often bitter experience of your employer who may be able to add a little to your textbook knowledge of his chosen field.

Don't become too inventive. A lot of your brainstorms which you feel will revolutionize the industry are probably "old stuff" to your boss and were no doubt rejected only after having been considered from all conceivable angles. When you do get an idea think it over from all possible viewpoints and then, if you are reasonably certain it is original, mention it to your boss. If he tells you it's no good forget it—he knows what he is talking about; that's why he's boss.

Above all, refrain from pressing the matter; for your arguments, lacking the background of experience, are apt to be very annoying. If you are invited to discuss something, fine, but keep in the back of your head the fact that your chief, being human, would rather hear "you" than "I".

Wisdom of Silence

The wisdom of silence and the folly of prolific inventiveness was once impressed upon me in a very embarrassing manner. I had designed a piece of testing equipment which in the light of my then youthful exuberance looked wonderful on paper and which I thought would greatly simplify a certain inspection process. My chief showed the enthusiasm of a housewife for an early morning peddler; but I argued and argued. Money was not so scarce in those days and finally he consented to build a sample.

The first trial proved promptly and conclusively that the idea was a flop and sheepishly I reported to my chief. He literally took me by the hand and led me to an old store room where, after rooting around a bit, he dragged forth a duplicate of my invention.

Another lesson can be learned from the preceding anecdote and it deals with the method of accomplishing something. When you are assigned to a job it is up to you to get it done and it will often be left to you as to how you go about it. This is an excellent opportunity for you to make a number of enemies by stepping on lots of toes or to show your resourcefulness. Suppose, for instance, you are assigned to make an investigation of a phase of your concern's activities. You can barge in on a lot of division heads and say with an "I'll get it or else" attitude: "My boss wants this and that." You will obtain the information; but not because the heads want to give it to you but rather because they don't want any unpleasantness.

At that rate you'll soon be looked upon as the nuisance you probably are anyway and get no particular credit for your efforts. On the other hand you might make an intelligent study of the files and probably dig out all or much of the data yourself.

Asking questions of knowing persons is, of course, an excellent method of learning, but the practice can be carried too far. Before you dash up to someone with a big how, why, or what, make sure the answer isn't on the next page of the file.

Chances are that your training course will include a spell in the shops to acquaint you with the manufacturing end of the business. This offers a fine chance to make a lot of worthwhile friends and get a viewpoint on the industry, and life, that the man who has never left his desk is likely to miss entirely. It also shows how you get along with the shop personnel and is an excellent yardstick of your potential ability to handle men.

The shop men can teach you many "tricks of the trade" and will be glad to do so provided you don't let your super-intellectual self start telling them how to do their job.

Likewise a term in the field on erection or service work can be very profitable if you avoid the same pitfalls. Try to avoid building the reputation for yourself that will cause the field boss to turn in a report similar to one sent in by a field engineer with my employer. That report read: "Job progressing satisfactorily in spite of presence of two cadet engineers."

Good Suction Means Fewer Troubles

Many operating troubles with centrifugal pumps are caused by faulty suction-pipe hookups. Here are some common mistakes and how to correct them

By RUSSEL K ANNIS
Consulting Pump Engineer, Asheville, N C

FAULTY SUCTION CONDITIONS are common sources of difficulty in operating centrifugal pumps. We no longer, however, believe that maximum suction lift of a centrifugal pump is 15 ft, that anything less than 15 ft is perfectly safe, and that anything over 15 ft will almost certainly lead to disaster.

Even when this was the accepted rule, it was suspected that there was more to the problem than that. Installations were reported with satisfactory performance where suction lift was 28, or even 30 ft, vertically, from water level up to pump center. Yet on other installations, pumps gave trouble where the suction lift was even 10 ft or less.

Any pump that could suck water up 28 ft vertically was dismissed as a freak. Pumps which fell down at 10 ft, though, could not be dealt with so easily. Complaints came in. Something had to be done. Usually, sages observed that pumps which couldn't lift water by suction as much as 15 ft or more were for low-head service. That is, low total head, and so the rule was set up that suction lift must not in any case exceed half the total head. This rule is still used occasionally, even though it is known to lead to difficulties in certain cases, and to be altogether too conservative in others.

When in doubt about the suction lift of a pump, the safest course is to consult the pump manufacturer. High-speed pumps, as a general rule, have lower suction lifts than low-speed units, and large pumps are more questionable than small ones.

When the suction limit on a pump is known, the suction pipe can be laid out so that suction lift, including all losses, will not exceed this limit. Preferably, the lift should be kept as far as possible within this limit.

It often happens that, because of a low or varying water level in the suction bay, combined with a high elevation of pumping-room floor, it is not always possible to keep this lift within

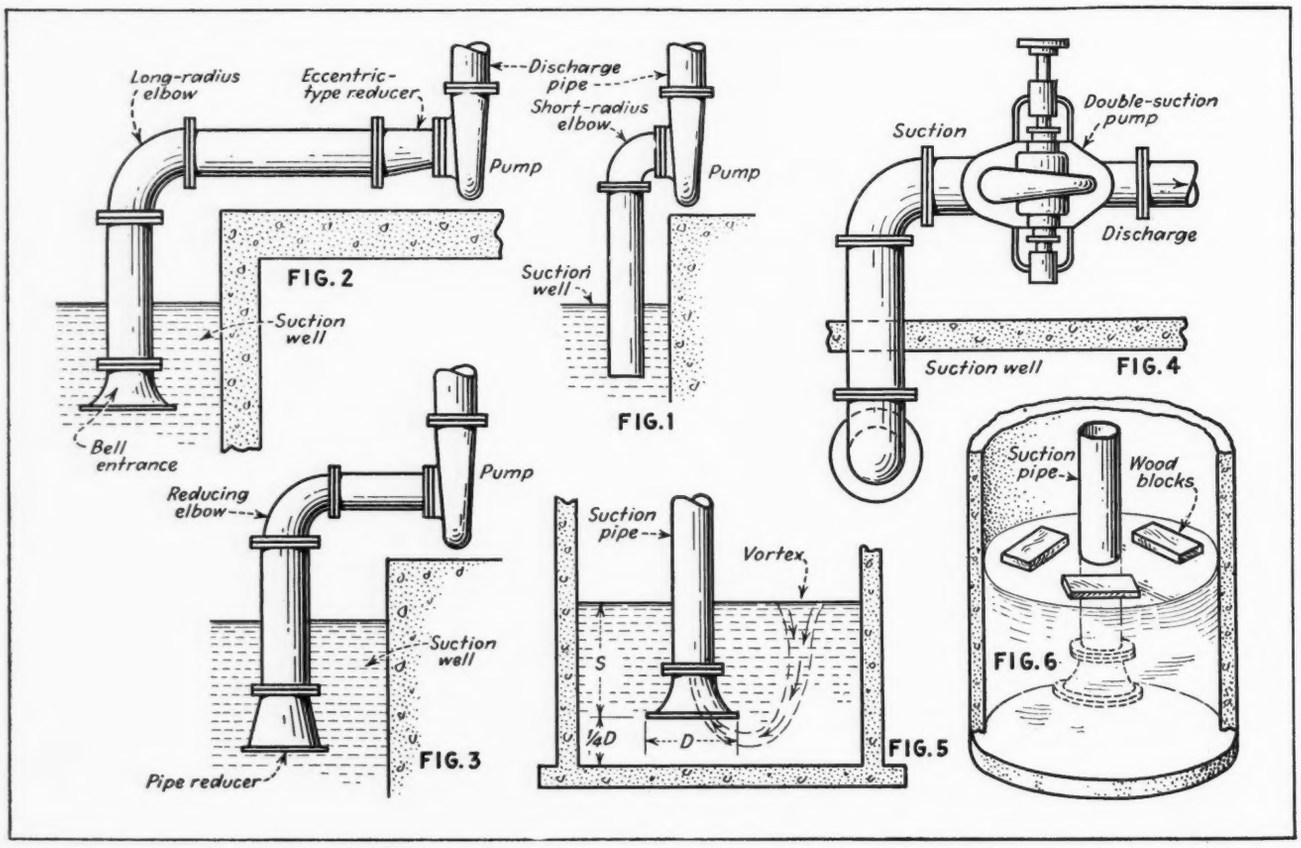


Fig. 1—A common mistake is connecting elbow directly to pump suction flange. Figs. 2 and 3—Two ways of correcting the mistake Fig. 1. Fig. 4—Bringing suction pipe in from side causes thrust on double-suction pump. Fig. 5—Vortices cause air to be drawn into the suction pipe. Fig. 6—Vortices eliminated by floating pieces of wood on surface of suction well

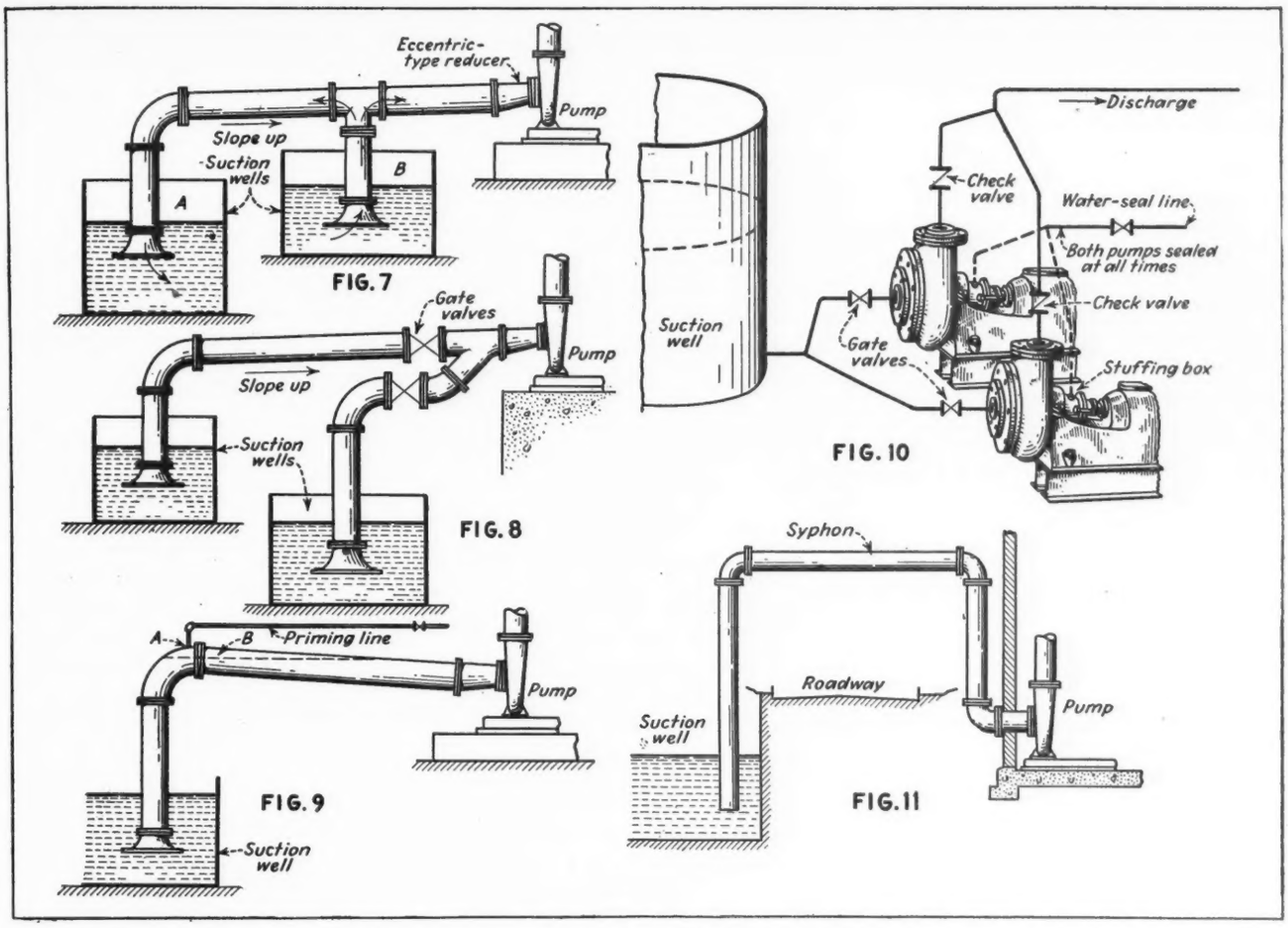


Fig. 7—When pumping from more than one source at different levels, water will syphon down to the lower level. Fig. 8—When suction pipe has two or more branches, put a gate valve in each branch. Fig. 9—When suction pipe slopes down to pump, prime by vacuum at highest point. Fig. 10—Two pumps take water from a common suction pipe. Fig. 11—Suction looped up over a roadway

limits of the pump. In that case, it is necessary to obtain a pump which will give the required lift, rather than to purchase one on price and efficiency. This, however, is not so good a procedure, because it might call for a more expensive and less efficient pump than one with less suction ability.

The suction pipe should be adapted to the pump, and not the pump to the pipe. Far too often, the entire pipe layout is made without considering suction lift. Many times, after pumps are installed, they are noisy and inefficient because of excessive suction lift which could have been reduced easily by locating the floor line at a lower elevation or the water level at a higher elevation. Such a change might permit pump manufacturers to offer pumps of higher speed, lower cost, and better efficiency.

Suction lifts can be reduced by proper arrangement of piping as well as by changing vertical distance from water level to pump. The suction pipe can be enlarged, if necessary to reduce friction, and fittings can be selected or arranged to give a lower suction lift.

Decreasing the suction lift obviously will decrease total head on the pump; hence, make a saving in the power required. This, however, is not the principal reason for keeping the suction lift small. Excessive suction lift causes rapid wear of pump parts, noisy operation, loss of capacity and efficiency out of proportion to what would be expected. To avoid these troubles, keep the total suction lift within the manufacturer's limits.

Pump Does the Work

Some operators have the erroneous idea that atmospheric pressure furnishes the energy for raising water up to the pump and that the pump does all the work beyond that point. This is not correct. All the burden of raising water from one level to another, including all losses and the suction lift, must necessarily come on the pump. The closer the pump is to the intake-bay level, the better for general performance.

A full list of mistakes made in suction-pipe layouts would be practically limitless, but the most frequent ones are shown in Fig. 1. Here the elbow is shown bolted directly to the suction flange of the pump. This is bad practice because eddies, set up by the elbow, often cause shock and noise upon entering the impeller. A piece of horizontal pipe should be inserted between the elbow and the pump, Fig. 2. Make the length of this pipe at least equal to two pipe diameters and preferably longer. When the pump is to be tested after installation, the horizontal pipe must be quite long. Authorities vary as to the length required; some specifications call for as much as 20 diameters. My experience is that 7 diameters will give uniform manometer readings.

In Fig. 1, the elbow is a short-radius ell, but a long-radius elbow is much better, Fig. 2. The submerged end of the pipe in Fig. 1 is just a plain pipe, but a bell-shaped entrance is preferable, Fig. 2. Where a bell entrance is not available, a pipe reducer, as in Fig. 3, can be used on the submerged end of the pipe.

A reducing elbow, Fig. 3, makes a neat looking job, and is satisfactory unless the horizontal run is too long. The horizontal run is often made the same size as the pump-suction nozzle. Where the horizontal section is so long

it causes excessive pipe friction, use a standard long-radius ell and a short reducer at the pump suction. Reducers, used on horizontal runs in the suction, should be of the eccentric type, Fig. 2, to prevent formation of air pockets.

Fig. 4 shows the plan of a double-suction pump. The elbow, which is in a horizontal plane, is too close to the suction flange and will cause a thrust on the impeller. This can be avoided by using a piece of straight pipe between the elbow and the suction flange. Wherever there is not room for such a pipe, it must be remembered that a thrust will probably result, even on an otherwise hydraulically balanced pump. Provision must be made in the bearings to take care of this thrust.

When the suction-pipe intake is too near the surface of the water, as indicated by *S*, Fig. 5, vortex swirls will be set up. These, if they become violent enough, will actually suck air into the pump. They are much more likely to occur with just a plain pipe end than with a bell-shaped entrance and are more frequent at high than low velocities. Where water level must be pumped down to near the end of the pipe, extra large pipe entrances must be used. It may also be necessary to reduce pump capacity by throttling for the last few feet of pumping to avoid air entering the pump and loss of prime. Where this is not feasible, vortices can be controlled by floating several pieces of wood on the water surface, Fig. 6. These must be large enough so that they will not be drawn up into the pipe by suction.

As shown in Fig. 5, distance between the end of the suction bell and bottom of the sump or tank should not ordinarily be less than one-fourth the bell-mouth diameter. Where this distance must be less than $\frac{1}{4}D$, an extra large bell mouth should be used.

It sometimes happens that one pump is required to draw water from several sources, as in Fig. 7. Where these sources are at different levels, operation will not be successful because water will be taken entirely, or almost so, from the source with the highest water level. Thus, if well *B* is at a higher elevation than well *A*, the pump will take its water from *B*. At the same time, water will be syphoned from the higher well into the lower one if the pipelines are large enough. For successful operation, install gate valves, preferably near the pump for convenience, Fig. 8. Then, water can be drawn from either or both wells as wanted by regulating valve openings.

Suction-Line Slope

Suction lines should slope upward towards the pump, as in Figs. 7 and 8, especially if they are long. Where suction pipes are comparatively short, it is satisfactory to have them level. They should never slope downward toward the pump, Fig. 9, unless there is a vacuum line connected into the highest point as at *A*, in order to remove all air when priming. It is possible to prime the pump without vacuum at the highest point. There will, however, always be a pocket of air, as at *B*. This pocket, whenever there is a surge in the suction line, may be drawn into the pump and cause loss of prime. It is best practice, where an installation like Fig. 9 is unavoidable, to prime by vacuum at *A*.

Fig. 10 shows two pumps connected into a common source by one pipe branching into them. Under some circumstances, this arrangement is satisfactory, but it is advisable to use gate valves as shown. With high suction lifts, there is always the possibility that with both pumps running, either or both will not operate properly. This, however, is a question of application, and will not ordinarily cause trouble.

One instance comes to mind of two pumps installed as in Fig. 10, where water elevation in the suction well was higher than the pumps so that they could be started without priming. When either pump was running, however, pipe friction was sufficient to cause a partial vacuum at its suction nozzle. This would draw all water from the inoperative pump and cause it to become airbound from air leaking in through the stuffing boxes. Then, when the dry pump was put into service it would not prime, because the air had no way to escape. This condition was corrected by interconnecting the water-seal pipes as shown, so that both pumps were water sealed at all times.

Fig. 11 shows another unusual suction-pipe installation where it was necessary to cross over a roadway. It would have been better to have driven the pipe under the road, but for some reason, it was installed overhead, not ordinarily to be recommended. The installation operated successfully because the vertical lift was low and comparatively short so that a pipe size smaller than usual could be used without making the total suction lift excessive. Then, high water velocity carried any air that tended to accumulate in the pipe along into the pump. Otherwise, air would accumulate at the top of the syphon and be carried as a large bubble, by a water surge, into the pump, causing loss of prime.

Exhaust Lines

By L N ROWLEY

At Louisiana Station, Baton Rouge, Bill Gurney told me how building housings over filters in the extensive water-conditioning plant killed algae that had formerly flourished there. The answer—for those not familiar with the life and habits of these pesky critters—lies in the fact that one branch of the family can live only in sunlight. Cut off the supply of Vitamin D and you've got the little green fellows right where you want them.

The National Advisory Committee for Aeronautics finds that rivet heads on the skin of a big plane cause enough drag to require 180 extra horsepower, or about 270 lb more engine and propeller. If welding replaces riveting it would seem to be another case of "gone with the wind".

Supt Frank Pearce was busy checking a dismantled governor when I stopped in at the Alexandria, La., municipal plant, but he took time out to talk of modernization. Biggest changes are taking place in the turbine room where a new unit now drives an existing 2500-kw generator and a completely new 4000-kw unit helps boost efficiency. Next step will probably be replacement of two small machines about 30 years old, to be followed by an increase in throttle pressure from 150 to 400 lb. The three 50,000-lb-per-hr gas-fired boilers, installed in 1935-36, were designed with this development in mind.

At the large sawmill of Hillyer, Deutsch, Edwards, Inc, at Oakdale, La., burning sawdust and hogged wood waste generates enough steam to meet all mill power requirements with enough left over to make possible sales of power to a neighboring public-utility system. Wonder how many industrial plants and utility systems are missing a good bet by not cooperating in a similar fashion?

Here's how to determine exact location of ground in large alternator field coils before disturbing the winding

By JOHN G NOEST
Production Department
Consolidated Edison Co of N Y, Inc

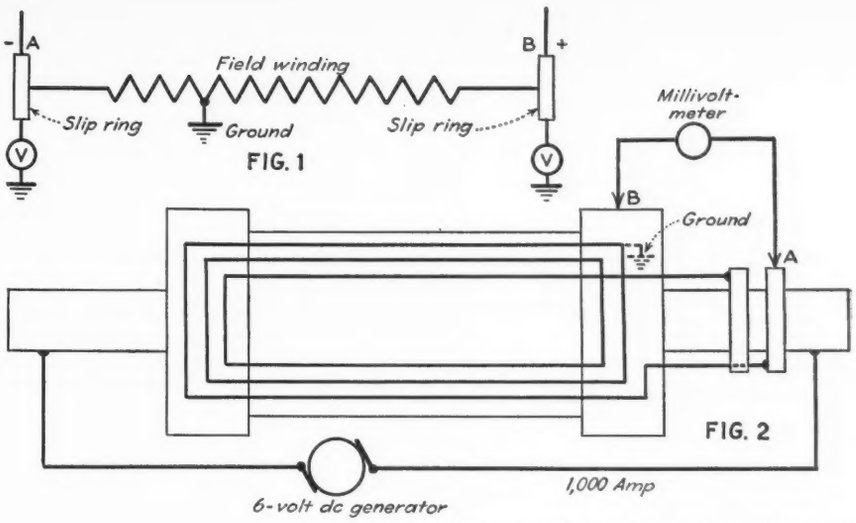


Fig. 1—This test gave approximate distance of fault from slip rings. Fig. 2—Method of locating ground under shrink ring nearest the slip rings

Test Tags Field-Coil Fault

WHEN A GROUND developed on the rotating field coils of a 160,000-kw turbine-generator, an interesting and unusual problem was presented in finding its physical location. Field excitation for this unit is normally supplied jointly from station excitation bus and generator-shaft exciter. To limit the physical extent of the circuit involved in the fault, excitation was temporarily supplied from the shaft exciter. Then, to determine the approximate location of the ground, two voltmeters were connected to the collector rings, as in Fig. 1, and readings taken. These were from *A* to *B*, 188 volts; from *A* to ground, 73 volts; from *B* to ground, 115 volts. This placed the approximate location of the ground, $(73 \times 100) \div 188 = 39\%$ of the winding length from ring *A*.

Using two voltmeters in this manner was justified. Insulation resistance of the rest of the circuit was very high compared to resistance of the ground in the rotating field. This definitely established the ground in the field winding and not on one of the rings. We then decided to remove the rotor, which weighs 135 tons, for further investigation.

After the rotor had been removed, a fault-location test was repeated, using a standard power-cable loop fault-locating set. With this, the fault location was determined to be 38.5% of the circuit length between *A* and *B* from collector ring *A*. Next step was to make a test to determine physical location of the fault.

A 1000-amp, 6-volt generator was connected to each end of the main shaft and a 1000-amp current circulated through it, Fig. 2. Our thought was that the field winding would take on a potential equivalent to that existing in the rotor shell at the point of fault.

In discussing this method, it was brought out that actual location of the fault in relation to a point on the rotor surface depended upon distribution of current in the rotor body. In other words, it depended upon shape of the equi-potential surfaces in the rotor body. For about 70% of the length of the rotor body, equi-potential surfaces were approximately plane surfaces at right angles to the rotor shaft. For the other 30% of rotor length, equi-potential surfaces were complicated shapes and indications within these distances could not be depended upon.

Millivoltmeter Test

A millivoltmeter was used for exploring, one lead being connected to the collector ring *A*, and the other lead being equipped with a hardened-steel point for better contact on the rotor body iron. The hardened-steel point was moved along the rotor until at point *B* no deviation was obtained, which happened to be under the shrink ring at the collector end of the rotor. The shrink ring, which keeps the field-winding end turns in place against centrifugal forces, makes a solid electrical connection with the rotor body. For this reason the indication was reliable.

After the shrink ring had been removed, the field-winding end turns were found to be encased in aluminum shields. No sign of burning appeared on these shields to show where the ground was. Therefore, testing by using a welding set to circulate 120 amperes was decided on. Connection was made to one slip ring and another connection to the interlaced aluminum shield on the end turns, on one of which it was reasoned the ground should be.

Using a millivoltmeter, we found that the highest reading occurred at one spot on a partly bulged shield. As a further check, thermometers were used to measure the temperature of these shields. The spot which was indicated as the point of ground by the millivoltmeter test showed the highest temperature rise. When the shield was finally removed, we discovered that the test methods had located the ground exactly.

The ground was caused by uneven expansion of individual turns of the same coil. These coils are wound with copper bar 0.25 x 1.25-in. in cross section. One of these bars, because of expansion, had pushed through the insulating tape, touched the aluminum shield and caused the ground.

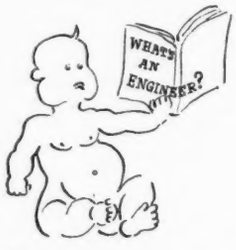
I have only described high spots of the testing necessary to locate the ground fault, but there were also many problems which came up in making repairs, one of which was application of dry ice to assist in removing the shrink ring from the field. It was necessary to expand the shrink ring with heat which flowed through the ring to the rotor core. Therefore, to expand the ring with heat faster than the parts under it, dry ice was applied to these parts.

Speaking of Power

A reader with a lot of stoker experience claims that most plants are designed "upside down". First you pick a boiler. Then you pick a stoker to go under it. Finally, you hunt for a coal that will burn well on the selected stoker. . . . To turn this process right side up, this reader would start with the fuel, picking the coal that gives the highest Btu per dollar, delivered at the plant. Next he would determine the kind, number and size of stoker units required for the given load conditions. Last of all he would select the boilers. . . . Sounds like a sensible procedure, but some operators may object to getting married to a single grade of coal. Wouldn't it be smart to consider also the other coals which might some day be a better buy. There's nothing like giving coalmen a little potential competition.

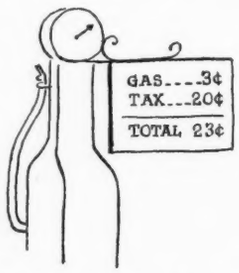
Object to Marriage

A G Stuart of British Columbia wants POWER to run a good article on "pH", or hydrogen-ion concentration. Any other votes for this? . . . Incidentally, Stuart was presented with a son last October. On the birth registration form, Father Stuart listed his occupation as "engineer". It must be a mighty serious matter for a child to have an engineer for a father, because the registrar immediately wrote back for further particulars . . . Stuart sent me a copy of his reply, in which he presents evidence that he *is* an engineer if judged by job, experience and ability, but that "according to the law of British Columbia I am not an engineer and this holds good in about all the provinces of Canada, states of the United States and most countries that are up to date enough to finance a war". Which appears to be telling the registrar that he, Stuart, is not a *professional* engineer. . . . As far as the U.S. is concerned the situation is not as Mr Stuart imagines. In all or practically all, of our 48 states a man without a professional license may call himself an engineer as long as he does not do so in a way that implies that he is offering to practice professional engineering. That is the intent of most of the laws as we understand them, although occasional attempts have been made to prove that they mean something else. . . . POWER takes the stand that the operating engineer without professional license is, both by tradition and common sense, entitled to call himself an "engineer". If the time comes when state laws, interpreted by the courts, rule otherwise, we expect that the pressure of an aroused public opinion will force revision of the laws.



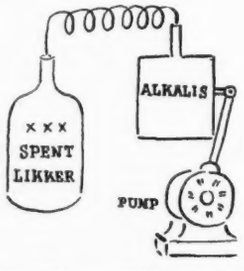
Serious Matter

For years it has been practicable to convert coal into oil and gasoline by the "hydrogenation" process if you didn't mind the cost. Europe, short of natural petroleum, has been doing it on an extensive scale. Over here petroleum is far too cheap to make coal hydrogenation worth bothering with right now. Some day the natural oil supplies will run low and we must then turn to our basic fuel, coal, to run automobiles and ships as well as stationary power plants. . . . When that coal reaches your greatgrandson's automobile it may be in the form of oil—or perhaps he will pull up at a curbside filling station to charge his tanks with gas under high pressure. . . . By the way, the U.S. Bureau of Mines is now mixing pulverized coal with oil and heating the mixture to 824 F under 3000 lb pressure. The experiments yield 70 to 75% convertible to gasoline.



Gas Far too Cheap

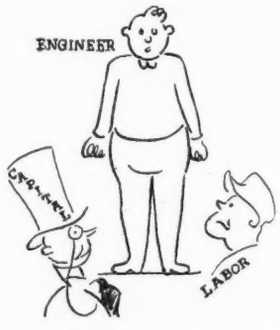
It's a safe bet that research will solve most of our technical problems in time to avoid critical situations. . . . Which reminds me of the story of "Ferron", told by the Research Foundation of the Armour Institute of Technology. Steel mills were discharging acid pickling wastes to streams—waste plus pollution. Now, thanks to research, they can treat the spent liquors with alkalis at 150 F. The precipitate, pressed into cakes and dried, is Ferron, a good filter material for the chemical industry. Other forms make a building material that is easily machined, fireproof and termite-proof.



Treat Liquor With Alkalis

I had hoped to make earlier note of the fact that Dipl. Ing. Hans Gleichmann, outstanding pioneer in the fields of radial-flow turbines and "once-through" high-pressure boilers, celebrated his 60th birthday on Feb 6 of this year. . . . In 1936 I had the pleasure of meeting Herr Gleichmann in his office at the Siemens Schuckertwerke in Berlin. He told me that I was personally responsible for his bald head. . . . It seems that Siemens Schuckertwerke first heard of the Benson Boiler through POWER about 16 years ago. They investigated, then purchased the world patent rights from the English Electric Company. During the next five years Herr Gleichmann lost a lot of sleep trying to make the Benson Boiler work properly. Hence the bald head ("and it's your fault, Mr. Swain"). . . . Present operation gets completely away from critical pressure and involves many other radical departures, worked out by Herr Gleichmann and his associates. More than 80 of the perfected units are now operating in various parts of the world.

Outstanding among America's educators is Dr Karl T Compton, president of M.I.T. Said he recently "Because of his professional status, the engineer stands in an intermediate position today between capital and labor. No other professional man has an equal opportunity to bring about that reciprocal confidence so sorely needed in our industrial society."



Intermediate Position

From Slash Pine to Paper— Power Pays the Way

Newspaper columnists justify their existence by telling the news behinds the news—the inside story of headline happenings. The booming paper industry of the South is just such a headline, and this time the news behind the news comes from the power plant.

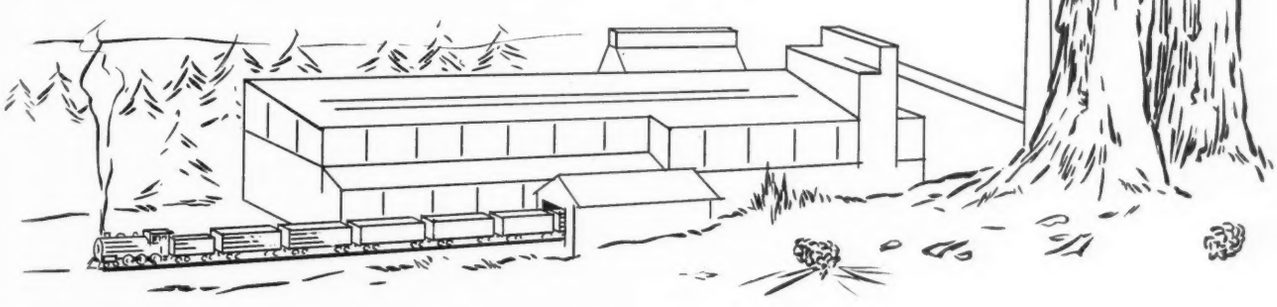
Search the reams of publicity about this industrial success story and you'll find drama aplenty—tales of scientific pioneers who believed that newsprint and fine paper could be made from Southern pine, tales of far-sighted business men who saw in its fast growth the promise of perpetual wood supply on which to build a stable industry. But nowhere will you find the story of another kind of pioneering, the work of engineers who gave the new Southern mills equipment and power plants that cut steam and power costs to new lows in a process where steam and power are vital ingredients.

Fair enough—the general public has little interest in technical advances as apparently undramatic as Btu chasing. But the industrial power engineer earns his keep by just such advances, and to him the story of power in the new Kraft mills is meat and drink, nourishment and inspiration. By habit he turns to the technical magazine for such fare, depending on its editors to spot significant developments and trends and bring him the news of his field.

As news trickled into POWER's editorial offices of Kraft mill after Kraft mill, power plant after power plant, the editors sensed an opportunity not to be missed. This was no place for the usual descriptions of single plants, useful though they might be. When a whole industry goes to town, with power developments playing a central role in the advance, that's NEWS!

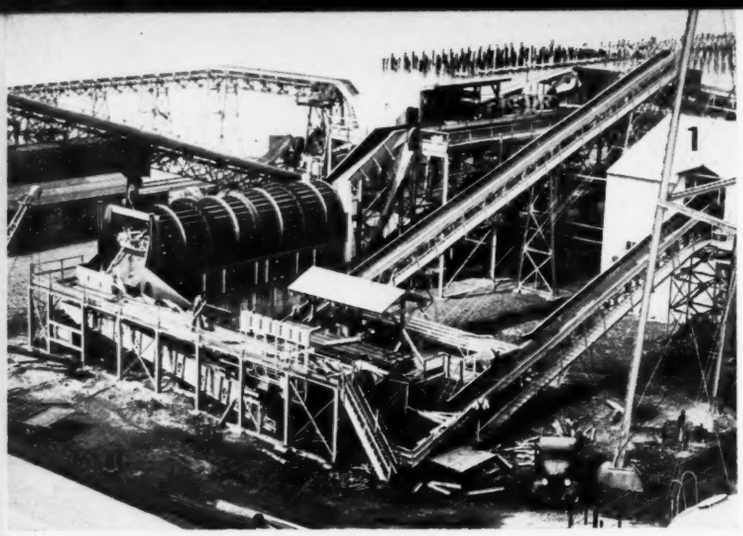
This survey is the answer. Realizing that most could be learned by standing these plants side by side, comparing similarities, studying differences, and reporting the entire development, POWER dispatched an editor on a 4000-mile trek, to gather data on the spot, to talk to men on the firing line.

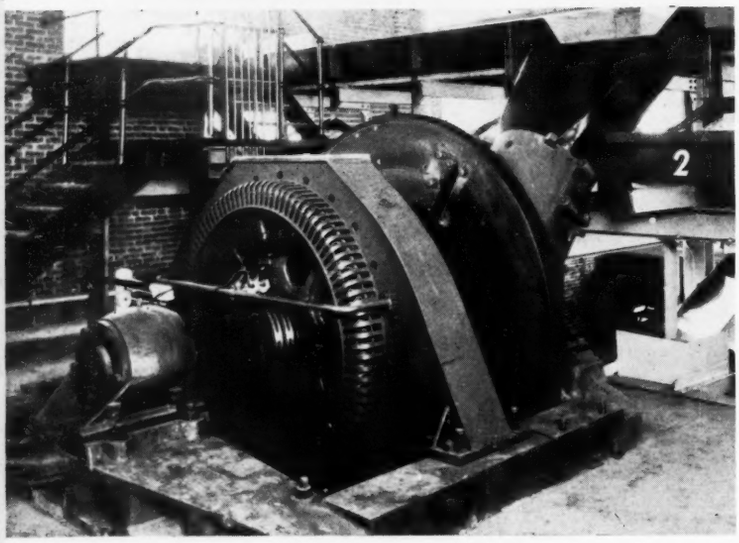
From the mass of facts supplied by operators, by design engineers and by equipment manufacturers, a rounded picture was drawn for power engineers in the paper industry and for power engineers everywhere who have a healthy interest in what the man on the other side of the fence is doing, and who believe that something can be learned from any power job well done.

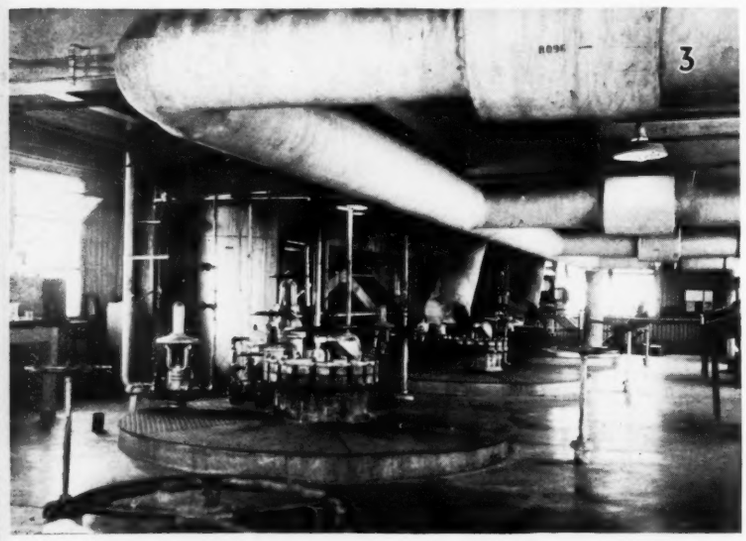


A POWER SURVEY, *mill to mill, of nine new power plants*

By L N Rowley, *Ass't Editor*





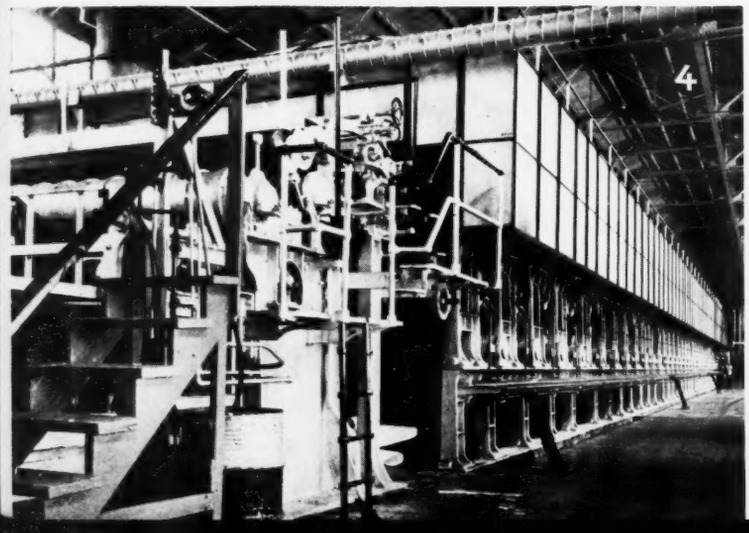


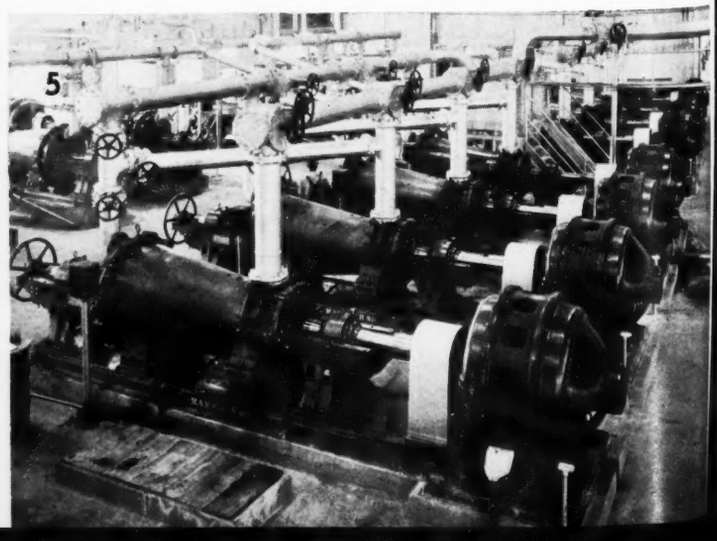
Pine to Pulp to Paper

KRAFT PAPERMAKING STARTS with pine logs about 4 to 5 ft long and averaging 6 in. in diameter. Frequent shipments by boat, train, or truck are necessary because fungus and rot spoil logs held too long in storage. Conveyors move logs from delivery point or storage pile to barking drums—huge, slowly rotating, steel-slatted barrels (1). Tumbling over and over in passage through the drum, the logs rub the bark from each other. Bark goes to storage bins in the boiler house; logs go to chippers (2) where high-speed rotating knives reduce them to pieces about 1 in. square and a fraction of an inch thick.

Chips go to storage bins above the digesters which are charged through swinging chutes (3). By cooking chips with white liquor (caustic soda and sodium sulphide), the lignin that binds cellulose fibres together is dissolved. Steam at 125-150 lb does the cooking; process may be direct, or indirect with steam and cooking mixture separated. After cooking, spent liquor is removed and returns to the recovery system. Cooked chips or pulp fibres go through a series of washing and screening operations to remove all traces of liquor and to break the pulp mass into individual fibres. If the pulp is to be bleached, it is done at this stage.

In mills making pulp only, the next and last operation is pulp drying. A machine (4), closely resembling a paper machine, spreads the watery mass evenly over a continuous wire screen. As the wire moves along, water drains to a chest below, and rolls help press the pulp and form the sheet. When strong enough, the pulp sheet leaves the wire and starts through a series of pressing rolls followed by a longer series of heated drying rolls. The finished pulp sheet is shipped, in bales or rolls, to other mills, usually for mixing with other pulp grades in the manufac-





ture of the various kinds of paper.

If pulp is to be finished into paper in the same mill, the drying process is omitted and pulp is further refined after washing and screening. In most Kraft mills, this additional refining is carried on in Jordans (5). These turbine-like units continue the process of reducing the pulp to individual fibres and of breaking and splitting the fibres so that they will mat or felt well.

Pulp flows from the Jordans to the paper machine, and passage over the wire, through press rolls and steam-heated dryer rolls produces a dry sheet, given final finish in calender rolls.

Kraft mills take process steam at two pressure levels, more than three-quarters of the total being used at the lower level. At the higher pressure (125-150 lb), major use is in digesters; at lower (35-60 lb), major use is in drying rolls of pulp machines and paper machines. Additional steam at the lower pressure goes to evaporators which concentrate black liquor before it goes to recovery furnaces, and to causticizing equipment where quicklime is added to the green liquor resulting from the recovery operation. Evaporator load is about five times that of causticizers.

In a pulp mill, principal power load is concentrated in the wood yard (barking drums, chippers, conveyors), with pulp-drying machine next in importance. That paper mills require about twice as much power as mills making only pulp can be charged to heavy power consumption in refining operations before pulp goes on the paper machine. As much as 300 kwhr per ton may be required to drive Jordans. Paper-machine energy consumption is also greater than that of a pulp-drying machine.

Requirements for bleaching are difficult to evaluate due to differences in methods and the secrecy surrounding them, but it is safe to say that a bleached-pulp mill requires about 30-50% more process steam and power than a mill making unbleached Kraft pulp.

Waste Fuels

On the credit side, the pulping process produces two waste fuels, bark and black liquor, in such quantities that up to 80% of total steam requirements may be generated from them in a mill producing dried pulp.

Amount of bark available per ton of pulp produced will vary somewhat depending on the size and density of the logs barked, and on the moisture content. Average moisture runs 45-50%, average heating value 8000-9000 Btu per lb, dry, and approximately 3000-5000 lb of steam can be generated from bark for each ton of pulp made.

POWER PICTURE

Here are steam and power loads, per ton of product, for typical Kraft mills, based on actual operating data. Differences in product and operating procedures account for the spread between high and low figures.

PULP MILLS

Total steam to mill, lb	13,000 – 17,000
H-p process steam, lb	3,000 – 8,000
L-p process steam, lb	9,000 – 10,000
Electrical energy, kwhr	350 – 525

Note: Spread in figures due mainly to bleaching, which increases requirements

PULP AND PAPER MILLS

Total steam to mill, lb	12,000 – 21,000
H-p process steam, lb	3,000 – 4,500
L-p process steam, lb	9,000 – 17,000
Electrical energy, kwhr	675 – 825

Kind of wood and method of cooking affect quantity and quality of black liquor resulting from digester operation. Average is 2500-3000 lb of solids per ton of pulp; average heating value of solids is 6500-7000 Btu per lb dry; approximately 7000-10,000 lb of steam can be generated per ton of pulp.

★ ★ ★

Steam and Power Balance

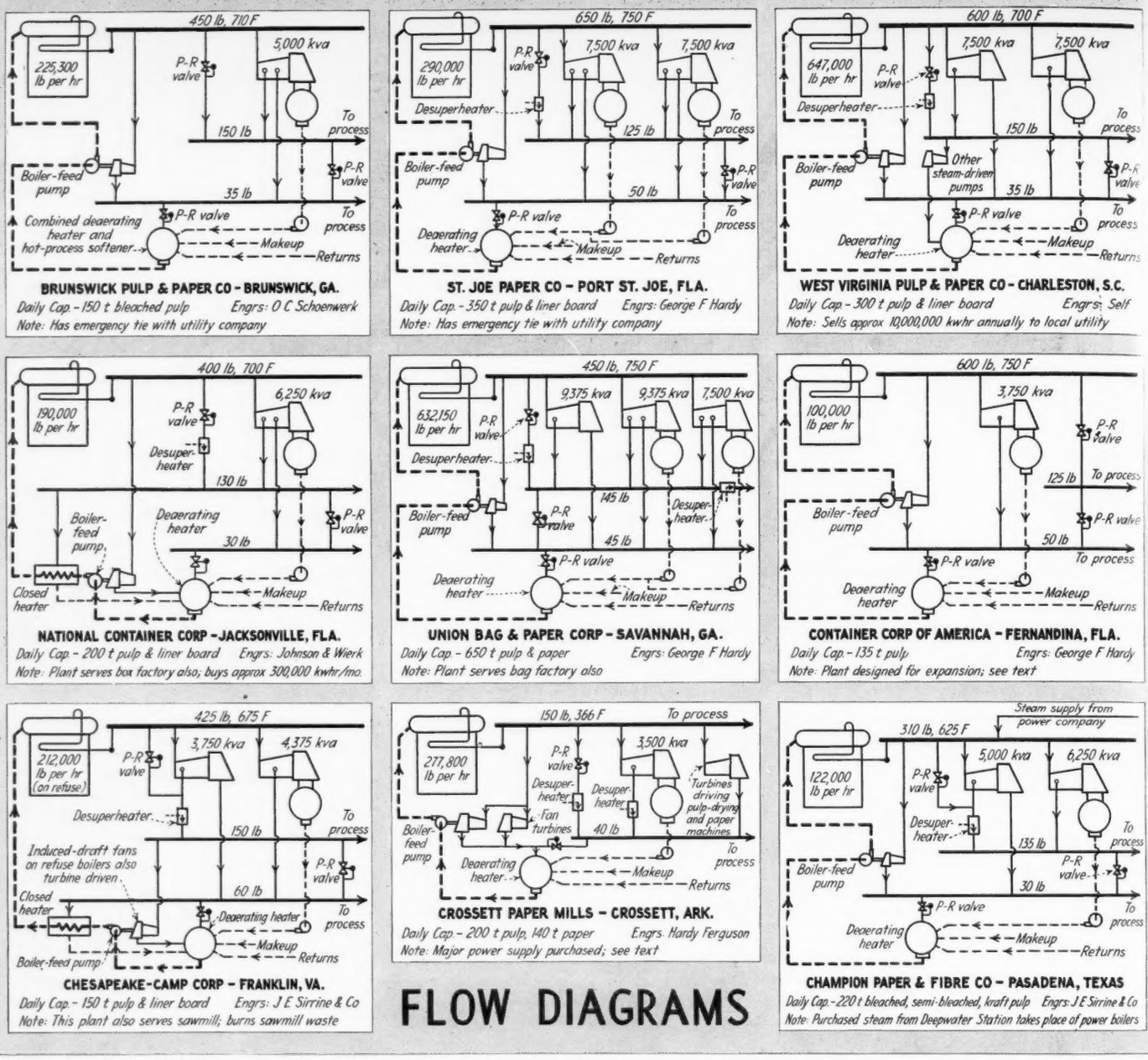
THE FLOW DIAGRAMS on the next page demonstrate more clearly than words that power problems can't be solved by formula, even when requirements are roughly similar. Therein lies the justification for the power engineer; he spots local conditions which make a given plant differ from others, and turns the differences to advantage.

A clearer picture of the problems faced by the designer of a Kraft-mill power plant and a better understanding of the solutions worked out in the plants surveyed will be gained by considering first those which depart least from the normal. Brunswick and St. Joe come first on that basis, followed by Union Bag, National Container and West Virginia. These five plants exhibit all the normal combinations employed to balance steam and power in Kraft mills.

All take full advantage of gains from high initial steam temperature, operating at 700 F or higher. Initial pressure selected depends on steam-power balance and investment required. Raising initial pressure produces more power from a given steam flow, but also increases equipment costs. Best balance point from both an operating and economic standpoint is in the 400–650-lb range, which produces all power requirements from average steam flows with a minimum quantity of steam going to condenser.

In arriving at a heat-balance arrangement, nature of loads as well as average quantities must be considered. Paper-mill operation is scheduled, as far as possible, to give continuous production at close to rated capacity, for periods ranging from several weeks to several months. Since barking, chipping, and cooking are essentially batch operations, variations in instantaneous loading enter the picture, but not importantly from the heat-balance standpoint. Average hourly loads follow production rate fairly closely, and since operation at low production rates is avoided where possible, there is little difference between peak and average loads.

Thus, the average plant can save by concentrating generation in a few units, since combinations of units to meet high- and low-load conditions are not needed. Because of the waste-fuel situation, this reasoning cannot be fully applied in the boiler room, but it does guide boiler selection. Concentration of generation makes provision of standby equipment expensive since to be really effective, standby capacity must equal largest unit whose outage


450 lb, 710 F
225,300 lb per hr
P-R valve
5,000 kva
150 lb
To process
Boiler-feed pump
35 lb
Combined deaerating heater and hot-process softener
Makeup
Returns
BRUNSWICK PULP & PAPER CO - BRUNSWICK, GA.
Daily Cap - 150 t bleached pulp Engrs: O C Schoenwerk
Note: Has emergency tie with utility company
650 lb, 750 F
290,000 lb per hr
7,500 kva
Desuperheater
125 lb
50 lb
Deaerating heater
ST. JOE PAPER CO - PORT ST. JOE, FLA.
Daily Cap. - 350 t pulp & liner board Engrs: George F Hardy
Note: Has emergency tie with utility company
600 lb, 700 F
647,000 lb per hr
Other steam-driven pumps
WEST VIRGINIA PULP & PAPER CO - CHARLESTON, S.C.
Daily Cap - 300 t pulp & liner board Engrs: Self
Note: Sells approx 10,000,000 kwhr annually to local utility
400 lb, 700 F
190,000 lb per hr
6,250 kva
Desuper-heater
130 lb
30 lb
Closed heater
NATIONAL CONTAINER CORP - JACKSONVILLE, FLA.
Daily Cap - 200 t pulp & liner board Engrs: Johnson & Wierk
Note: Plant serves box factory also; buys approx 300,000 kwhr/mo.
450 lb, 750 F
632,150 lb per hr
9,375 kva
145 lb
45 lb
UNION BAG & PAPER CORP - SAVANNAH, GA.
Daily Cap. - 650 t pulp & paper Engrs: George F Hardy
Note: Plant serves bag factory also
600 lb, 750 F
100,000 lb per hr
3,750 kva
125 lb
50 lb
CONTAINER CORP OF AMERICA - FERNANDINA, FLA.
Daily Cap - 135 t pulp Engrs: George F Hardy
Note: Plant designed for expansion; see text
425 lb, 675 F
212,000 lb per hr (on refuse)
3,750 kva
4,375 kva
Induced-draft fans on refuse boilers also turbine driven
150 lb
60 lb
Boiler-feed pump
CHESAPEAKE-CAMP CORP - FRANKLIN, VA.
Daily Cap - 150 t pulp & liner board Engrs: J E Sirrine & Co
Note: This plant also serves sawmill; burns sawmill waste
150 lb, 366 F
277,800 lb per hr
3,500 kva
Fan turbines
Turbines driving pulp-drying and paper machines
40 lb
CROSSETT PAPER MILLS - CROSSETT, ARK.
Daily Cap. - 200 t pulp, 140 t paper Engrs: Hardy Ferguson
Note: Major power supply purchased; see text
Steam supply from power company
310 lb, 625 F
122,000 lb per hr
5,000 kva
6,250 kva
135 lb
30 lb
CHAMPION PAPER & FIBRE CO - PASADENA, TEXAS
Daily Cap. - 220 t bleached, semi-bleached, kraft pulp Engrs: J E Sirrine & Co
Note: Purchased steam from Deepwater Station takes place of power boilers
FLOW DIAGRAMS

would seriously curtail production. Most designers take the bull by the horns and provide no standby equipment, depending on the high availability of modern power equipment.

For smaller plants, one double-extraction condensing turbine-generator will get the call, while large plants can combine backpressure and condensing units, or several extraction-condensing units. Whatever combination is used, simplicity marks the entire arrangement in all the mills surveyed. Most auxiliaries are motor-driven, but it is customary to provide at least one turbine-driven feed pump for start-up and standby service. Single-stage feed heating answers the purpose in most cases; a deaerating heater takes exhaust from auxiliary drives, supplemented by steam from the low-pressure header. Reducer-desuperheater stations take care of short unbalances.

Hookups for Chesapeake-Camp, Container Corp, Crossett, and Champion exhibit adaptation to special conditions. At Chesapeake-Camp for example, the power plant serves the adjoining saw mill. Steam and power loads dovetail, the sawmill provides wood waste for fuel, and the net result is balanced operation with virtually all requirements met by waste fuels (see POWER, May, 1938, for detailed description).

Planning for mill expansion accounts for Container Corp's hookup. Adding another turbine-generator, arranged for 125-lb extraction and 50-lb exhaust, will absorb present excess boiler capacity and eliminate regular use of reducer to supply 125-lb steam. The result will be a conventional 2-unit hookup.

Opportunities for profitable purchase of power and steam influenced designs at Crossett and Champion. In the former case, dump power is available except during daylight hours in summer months; power for use in this restricted period originally came from the sawmill plant of the Crossett Lumber Co. Load growth made continued operation on this basis impossible, and it proved cheaper to install a turbine-generator than to buy power during the restricted period. Boilers can operate at high pressure if the situation should change to make generation of all requirements attractive. An interesting feature of Crossett's heat balance is use of turbine-driven dc generator to supply motors driving paper machine, rather than conventional mg set. Exhaust from turbine and other auxiliaries supplies the l-p process header.

At Champion, waste fuels produce as much steam as possible and the remaining requirements come from Deepwater Station, a plant built to sell steam and power to industrial customers and to supply byproduct power to a utility system.

Power Boilers

BURNING THREE or more fuels of widely different characteristics in the same plant makes for added complication in selection and operation of boilers. This is especially true of Kraft mills where the waste fuels, bark and black liquor, require firing equipment entirely different from that for the auxiliary fuel. In planning and operating such boiler plants, recovery boilers for burning black liquor are considered as a separate problem, and units for burning bark and an auxiliary fuel, either separately or in combination, are considered together as "power boilers."

Choice of auxiliary fuel depends largely on location of plant, and also to some extent on convenience and investment required. Thus both West Virginia and Chesapeake-Camp are in an area where coal and oil are competitive; but Chesapeake-Camp is equipped for oil only, while West Virginia is equipped for both and is now using pulverized coal. The answer lies in the fact that Chesapeake-Camp, operating in conjunction with a sawmill, normally meets all steam needs from waste fuels, with oil in a purely standby capacity, whereas West Virginia, a much larger plant, generates only about 40% of requirements from waste fuel. Minimum investment in auxiliary firing equipment is the requirement in the first case, while West Virginia, with a much heavier use factor, can afford to invest in dual equipment to take full advantage of changing prices.

For eastern seaboard plants, further south, oil is now, and probably will continue to be, the cheapest fuel, and since it is almost ideal for auxiliary service, these plants all use it. Crossett and Champion, in the heart of great natural gas areas, find this fuel ideal, as a minimum of handling and firing equipment is required.

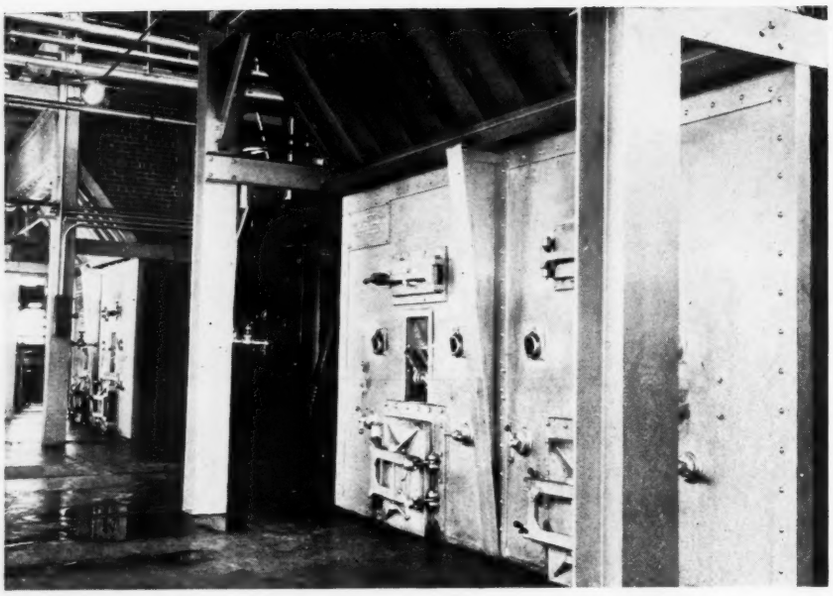
Data on power boilers in the nine plants surveyed is listed in tabular form below. Total power boiler capacity, related to size of plant, varies widely. With the exception of West Virginia and Crossett, none of the plants was designed to have a spare boiler, but in nearly every case operating boiler capacities exceed design figures, particularly on bark firing, giving spare capacity not originally counted on.

Most units are standardized, integral-furnace, 2-drum boilers, but West Virginia's coal-fired boilers are 4-drum bent-tube jobs, and Union Bag, Champion, and Crossett have some Stirling units. None of the units has an economizer, but the majority have air heaters. Equipping all boilers in the plant for firing the auxiliary fuel gives maximum operating flexibility; all plants do so. Number of boilers equipped with bark furnaces depends on how much additional operating flexibility is desired; plants with two units can shut down for grate cleaning while continuing to burn bark. Plants with only one bark furnace are not handicapped, however, since bark production is not a 24-hr process and since large feed bins compensate for variations in supply and consumption of bark. Incidentally, all mills try to burn the different fuels separately rather than in combination.

POWER BOILERS

Mill	No. boilers	Capacity, each lb per hr	Heating Surface: Boiler and waterwalls, sq ft	Heating Surface: Air heater, sq ft	Furnace: Volume, cu ft	Furnace: Heat release, 1000 Btu per cu ft per hr	Fuel	Burners: No. fans per boiler	Burners: Type	Forced-Draft: No. per boiler	Forced-Draft: Capacity lb per hr	Forced-Draft: Drive	Forced-Draft: Control	Induced-Draft: No. fans per boiler	Induced-Draft: Capacity, lb per hr	Induced-Draft: Drive	Induced-Draft: Control
Union Bag	3	43,750	4,785‡	2,502	3,100	25.7	Oil	3	Steam-atom.	1	50,200	M	D	1	57,600	M	D
	2	75,000	8,702	4,260	4,150	25.2	Oil	5	Steam-atom.	1	85,800	M	D	1	96,700	M	D
	2	75,000 50,000*	7,624	4,710	3,600	28.2	Oil-Bark	2	Steam-atom.	1	82,000	M	D	1	95,000	M	D
St. Joe	2	76,200†	8,825	3,410	4,056	30.4†	Oil-Bark	2	Steam-atom.	1	96,400	M	D	1	121,300	M	D
	1	48,750	8,419	3,410	4,056	16.1	Oil	2	Steam-atom.	1	96,400	M	D	1	121,300	M	D
West Virginia	1	48,000	7,293	3,300	3,550	23.5	Oil-Bark	3	Forced-draft Steam-mech.	1	54,000	M	D	1	85,200	M	D
	2	225,000	17,850	34,000	11,200	28.0	PC-Oil	4	Combination	1	294,000	M	V	1	324,000	M	V
National Container	1	35,000*	4,950	None	2,206	22.1	Bark			1	52,000	M	D	1	90,000	M	D
	1	100,000	9,979	10,350	4,704	29.8	Oil	3	Steam-mech.	1	109,000	M	D	1	130,000	M	D
Crossett	1	52,000 42,600*	5,740‡	None	2,925	25.7	Gas-Bark	3	Forced-Draft	1	54,900	M	D	1	58,700	T	D
	2	52,000	5,740‡	None	2,925	25.7	Gas	3	Forced-draft	1	54,900	M	D	1	58,700	M	D
Chesapeake-Camp	2	120,000 80,000*	14,098	None	6,580	25.1 19.9*	Oil-Bark Hogged Wood	3	Forced-draft, Steam-mech.	1	134,000	M	D	1	152,000	T	D
Champion	1	47,000	8,700	None			Gas-Bark	3	Forced-draft	1		M	V	1		M	
Brunswick	2	80,000 ⁂	12,367	None	5,670	21.9	Oil-Bark	3	Forced-draft	1	109,100	M	D	1	122,000	M	D
Container Corp	1	76,200† 45,000*	8,825	3,410	4,056	30.4	Oil-Bark (Future PC)	2	Convertible	1	96,400	M	D	1	121,300	M	D

NOTES: *All units have superheaters; none have economizers. Steaming capacity is given as maximum continuous output, for coal, oil, or gas, except where marked * which indicates capacity on bark. Furnace volume applies to main furnace only. Heat release is for coal, oil, or gas, unless marked * which indicates heat release on bark. Symbols: M = motor, T = turbine, D = damper, V = vane. † Units rated firing bark and oil in combination, at peak output. ‡ No waterwalls. ⁂ Units rated firing bark and oil in combination, maximum continuous output.*



Front of bark-burning furnaces at Brunswick, showing doors and levers for operating fuel pushers

Burning Bark

GONE ARE THE DAYS when bark and other wet-refuse fuels were chiefly known for the nuisance in getting rid of them. Improvements found in the new Kraft mills put efficiency into bark burning, and make it as easy and neat to handle as any solid fuel. With minor changes, methods used for bark handling and burning can be applied to other waste fuels high in moisture such as bagasse, tanbark, garbage, sewage sludge, and a host of others.

The drawing on the facing page shows a typical bark-burning furnace and feed bin. To start at the beginning, bark moves from woodyard to feed bin by way of inclined belt conveyors. Exception is St. Joe, where distance between woodyard and boiler house made it advisable to move bark pneumatically. At this plant, hogging reduces bark to evenly-sized small particles before entrance to a 10-in. pipe leading to cyclone and feed bin.

In the steel feed bins, conveyor screws, spaced at intervals in the bottom, undercut bark and move it to feed chutes. A single chute, with rotary feeder, serves each section of grate. Conveying screws and feeder are driven by a constant-speed motor through a variable-speed transmission, manually controlled. Bins may be above the furnace, as shown, which is most compact, or over the operating aisle in front of the furnace.

BARK-BURNING FURNACES

Mill	*No. of Furnaces*	*No. of Sections, each*	*Width, Each Section, ft*	*Capacity*		*Use Forced Draft?*	*Use Heated Air?*	*Secondary Air Tunnels?*
				Bark, lb per hr	*Steam, lb per hr per furnace*			
Union Bag	2	2	6	17,700	50,000	Yes	Yes	Yes
St. Joe	2	2	5.5	.....	45,000	No	Yes	Yes
West Virginia	1	3	4	15,000	48,000	Yes	Yes	Yes
National Container	1	2	4	9,500	35,000*	No	No	No
Crossett	1	2	4	12,500	42,600	No	No	No
Chesapeake-Camp.	2	3	5.5	.....	80,000	Yes	No	Yes
Champion	1	3	4.5	.....	.....	Yes	No	No
Brunswick	2	2	5	7,160	50,000*	No	No	No
Container Corp.	1	2	5.5	.....	45,000	No	No	No

* *Actual performance; other figures represent nominal ratings.*

As is more or less common practice with wood waste, bark is burned in a Dutch oven or extension furnace. Primary combustion occurs in the Dutch oven; gas, resulting from producer action there, burns completely in the main furnace. In most cases the oven is located as shown, but can be applied to either side or rear as necessary.

Bark, like wood, analyzes high in moisture and volatiles, and low in fixed carbon. The grate construction employed in the new Kraft-mill installations provides 3-stage combustion required by nature of the fuel. To review more or less familiar combustion elements, the three stages are: evaporation of moisture, distillation and burning of volatiles, and burning of fixed carbon. Evaporation and distillation need no air but do require heat, which comes from burning of volatiles and fixed carbon. Naturally, since no temperature increase will occur until evaporation is complete, rate of distillation depends on rate of evaporation, which thus controls rate of combustion. For satisfactory high-rating operation, the furnace must be designed to supply heat to the wet fuel effectively.

In the furnace illustrated, wet bark from the feed chute falls on a refractory hearth, sloped at 50 deg, and as it dries, it slides down to the second grate section where distillation occurs. Grate bars in the second section slope 45 deg, and horizontal air spaces prevent clogging. The suspended-arch roof is shaped to concentrate radiant heat on these grate sections, and the refractory hearth provides additional heat-holding surface where it is most needed. Controlled flow of fuel through a tight feed system prevents introduction of large quantities of cold air at a point where refractory temperature must be kept as high as possible.

Final combustion, consisting mainly of burning fixed carbon, takes place on the last grate section, which is inclined at a lesser angle and equipped with fuel pushers located between longitudinal grate sections. Operation of fuel pushers and dumping grates is by hand lever from the furnace front.

Burning of volatiles starts at the fuel-bed surface in the Dutch oven and continues in the main furnace. The forward-tilted bridgewall works with the arch contour to force lighter, hotter gas from the lower end to mix with heavier gas from the top. Overfire air, supplied through tuyere castings in the

bridgewall, promotes turbulence and so contributes to thorough mixing of combustion products.

Theoretically, it would seem that most air should come in over the fire, since most combustion takes place above the fuel bed. Actually, the major part of the air must be supplied through the grates to aid the heavy drying job to be done and, even more important, to keep grate metal cool. Tight furnace construction and an enclosed fuel bin and chute keep the amount of uncontrolled overfire air to a minimum so that what overfire air is supplied can be put to work to do the most good.

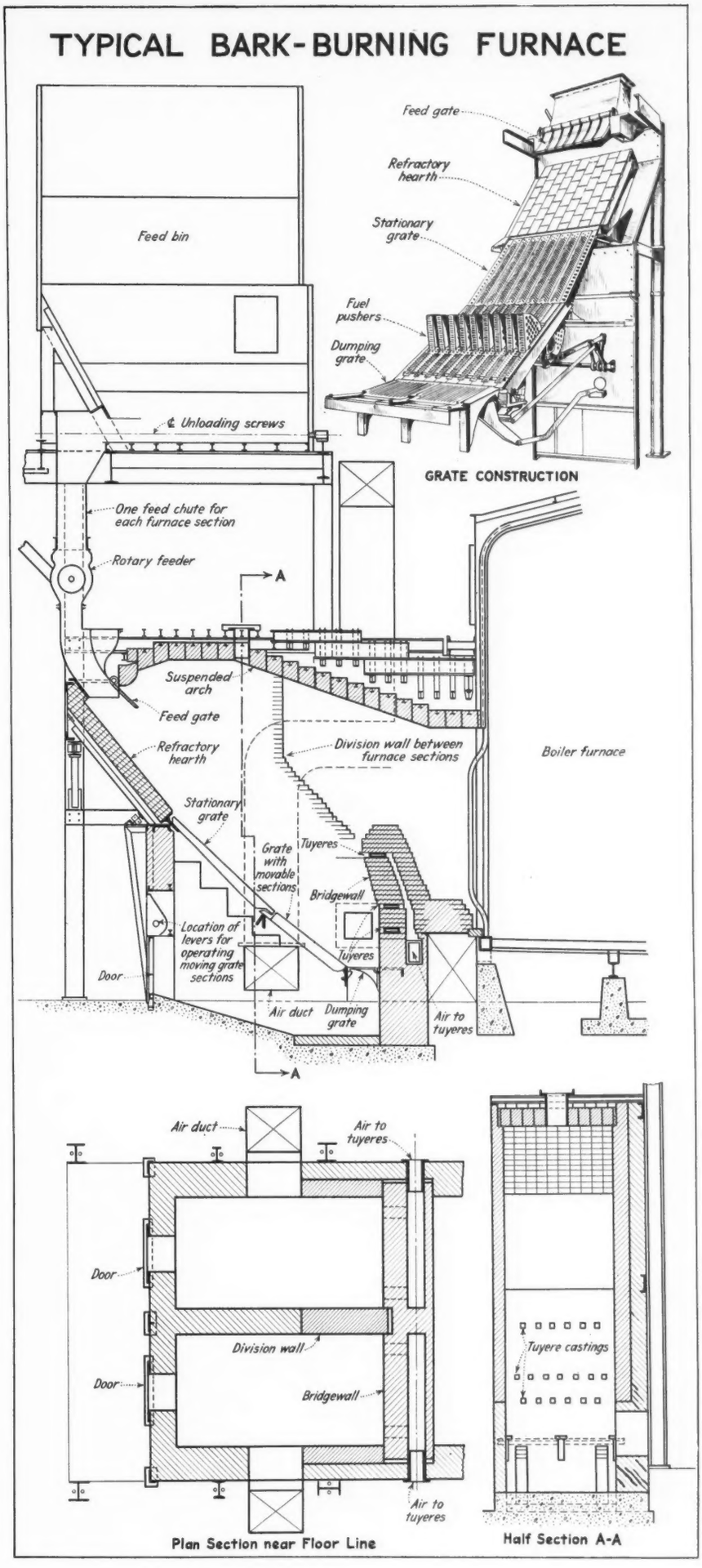
Operation

Bark-burning furnaces in mills surveyed were designed for burning rates ranging from 800 to 1500 lb of bark per ft of furnace width, per hr, with most in the neighborhood of 1200. On the average, these units actually produce from 3 to 5 lb of steam per lb of bark, or roughly 3500-5000 lb steam per foot of furnace width, per hr. Operation at rates above about 1000 lb bark per foot of width is frequently accompanied by carryover of unburned and partially burned particles, which collect on the floor of the main furnace and may accumulate in boiler passages and stack base. A common solution which permits high-rating operation without trouble from carryover involves installation of tunnels in the floor of the main furnace. Secondary air, supplied under pressure, aids burning of particles in the secondary furnace.

Combustion Control

Control of secondary air regulates CO_2; with wet fuel, it may be carried up to 16-17% without harm to refractories, due to relatively low furnace temperatures. Combustion control on bark-burning units is largely manual, since it is difficult to feed wet bark under automatic control. Usual practice is to set bark-feeding rate to more or less keep pace with bark supply, and to regulate air supply to maintain desired combustion conditions. Observation of CO_2-recorder readings or steam-flow air-flow meter pens aids operator's judgment. It is customary to control induced-draft damper setting automatically by a furnace-pressure regulator.

Most operators hold forced draft in reserve until needed to burn an extra-heavy supply of bark, since natural-draft operation lowers furnace temperatures and keeps down grate maintenance. Although preheated air improves combustion of wet fuels by aiding the drying process, heated air is not used on bark in most of the plants-



Recovery Boilers

IMPROVEMENTS in chemical and heat recovery from black liquor contribute vitally to the success of the newer mills and continued progress along these lines may be expected to play an important part in all future sulphate-process operations. Originated with no thought but recovery of valuable chemicals, the process now supplies a large share of all steam requirements of the typical mill; application of modern furnace and boiler practice did the trick.

Mills surveyed utilize either the Murray-Waern recovery unit, with its smelter furnace, rotary dryer, and evaporator scrubber, or the Tomlinson unit, with its spray-type furnace in which both dehydration and smelting occur. Still another unit is available which includes a spray-type furnace and evaporator scrubber.

The accompanying illustration shows typical Murray-Waern and Tomlinson units. In the former, hot gas flows back from the smelter furnace and rotary, through the waste-heat boiler to the evaporator scrubber. Preliminary concentration in multiple-effect evaporators brings solid content of the liquor to about 45–50% at entrance to the evaporator scrubber. In this unit, rotating elements dip into circulating liquor and present wetted surfaces to gas flowing through. Moisture evaporates from liquor and solid content increases to about 65%. Intimate contact between liquor and gas removes entrained solids, cutting down chemical loss up the stack.

Heavily-concentrated liquor is pumped to the rotary dryer where heat reduces it to black ash which drops from the rotating kiln to the smelter furnace, forming a deep fuel bed. Combustible lignins in the black ash burn with air passed through the fuel bed; further burning with secondary air, in upper part of furnace and rotary, completes combustion. Chemicals smelted from the ash run out the spout and into the dissolving tank.

Waterwall surface surrounds the smelter furnace; steam generated there joins steam generated in the waste-heat boiler for passage through superheater elements. Draft equipment comprises a positive-displacement blower for primary air, a secondary-air fan, and an induced draft fan.

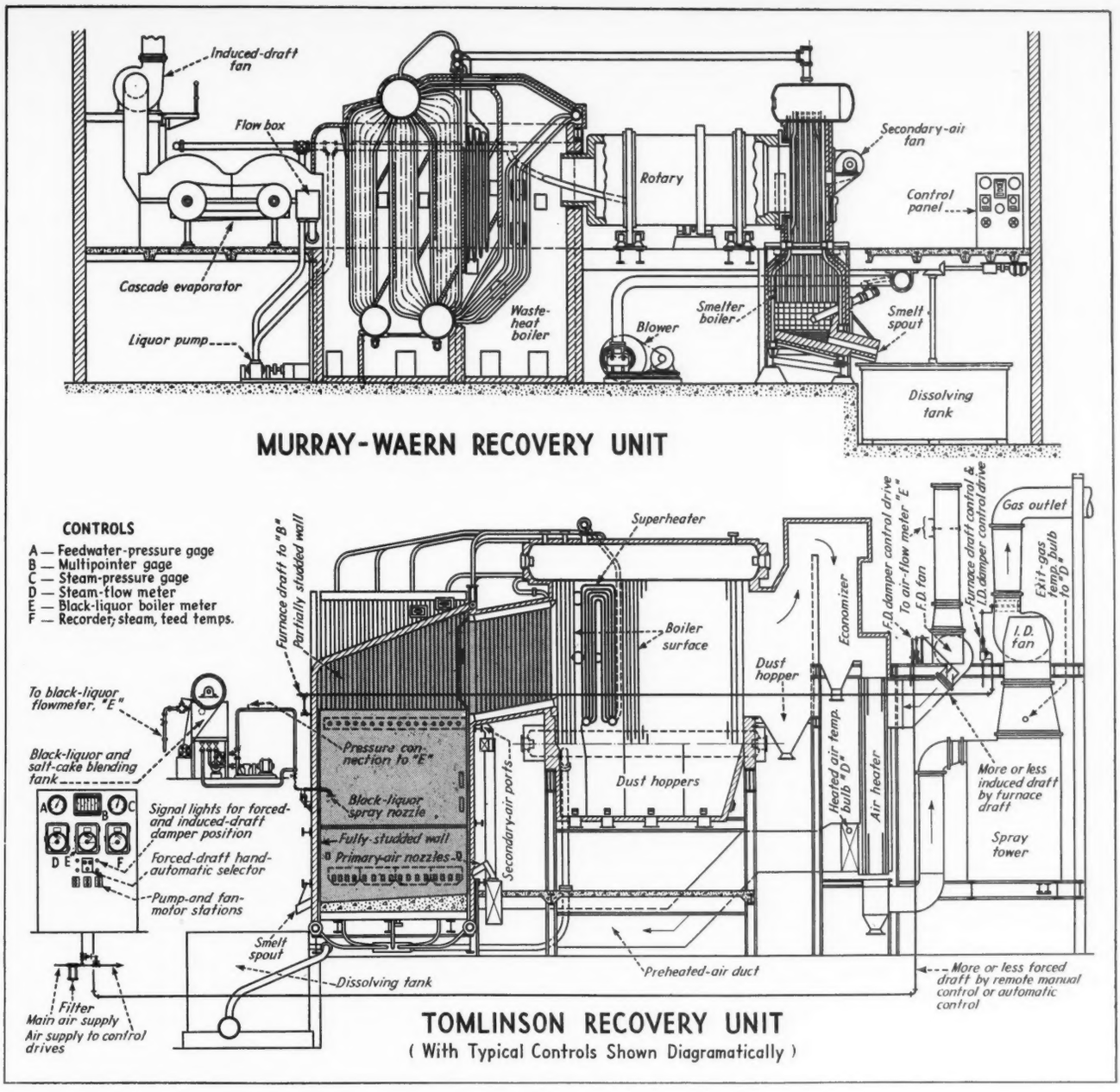
Automatic control is not usually applied to Murray-Waern units, but a complete installation of indicating and recording instruments and remote manual controls is customary. At West Virginia, flow of steam and black liquor is recorded and integrated, and control of the positive-displacement variable-speed liquor pump is accessible to the operator. A 10-point indicator shows draft in smelter furnace, at economizer outlet, and at evaporator-scrubber outlet; and flow of primary air; nozzle air pressures, and secondary air pressure. A 3-pen recorder measures gas temperature at evaporator and boiler outlets, and steam temperature. Control and instrumentation on the units at National Container resembles closely that illustrated and described for the Tomlinson unit.

In the Tomlinson unit, liquor dries to black ash or char, and smelting takes place in the same furnace. Starting with concentration of liquor in multiple-effect evaporators and addition of crushed salt cake (Na_2SO_4) to make up for a small amount of chemical lost in the cycle, preliminary steps differ from the Murray-Waern only in the amount of concentration taking place in the multiple-effect evaporators.

RECOVERY BOILERS

					Heating Surface			*Furnace*		*Forced-Draft*				*Induced-Draft*			
Mill	*No. units*	*Type*	*Capacity, each tons pulp per day*	*Capacity, each lb steam per hr*	*Boiler & waterwalls, sq ft*	*Economizer, sq ft*	*Air heater, sq ft*	*Volume, cu ft*	*Heat release, 1000 Btu per cu ft per hr*	*No. fans per boiler*	*Capacity, each lb per hr*	*Drive*	*Control*	*No. fans per boiler*	*Capacity, each lb per hr*	*Drive*	*Control*
Union Bag	3	T	67.5	33,700	4,093	2,650	3,980	1,700	35.5	1	56,200	M	D	1	72,300	M	D
	4	T	100	49,900	6,347	4,110	6,070	3,450	25.9	1	83,200	M	D	1	107,100	M	D
St. Joe	3	T	130	47,600	10,525	None	6,360	5,000	20.42	1	99,000	M	D	1	137,020	M HC	D
West Virginia	1	T	119	50,900	11,427	2,010	6,970	4,900	20.6	1	112,000	M	D	1	153,000	M	D
	3	MW	100	32,500	11,120	Integral	None	908 1,247	32.1	1	67,500	M	D	1	94,400	M	D
National Container	2	MW	100	30,000	11,120	Integral	None	908 1,247	32.1	1	65,000	M	VS	1	85,000	M	D
Crossett	3	T	85	40,600	6,107	None	4,125	2,800	23.0	1	61,100	M	D	1	86,670	M	D
Chesapeake	1	T	150	51,900	11,427	None	6,970	4,900	21.2	1	98,800	M	D	1	134,000	M	D
Champion	1	T	125	53,400	11,997	2,010	None	5,000	20.4	1	98,000	M	D	1	134,000	M	
	3	MW	85	35,000	11,120	Integral	None	908 1,247	40.2	1	81,000	M	VS	1	112,500	M	VS
Brunswick	1	T	150	65,300	11,902	2,010	6,980	5,100	25.0	1	120,000	M	D	1	160,600	M	D
Container Corp	1	T	130	47,600	10,525	None	6,360	5,000	20.42	1	99,000	M	D	1	137,020	M	D

NOTES: HC = hydraulic coupling, M = motor, D = damper, VS = variable speed, T = Tomlinson, MW = Murray-Waern. On Murray-Waern units, economizer is integral with boiler, volume of smelter furnace and rotary given separately (larger figure is rotary); forced draft comes from positive-displacement blower.



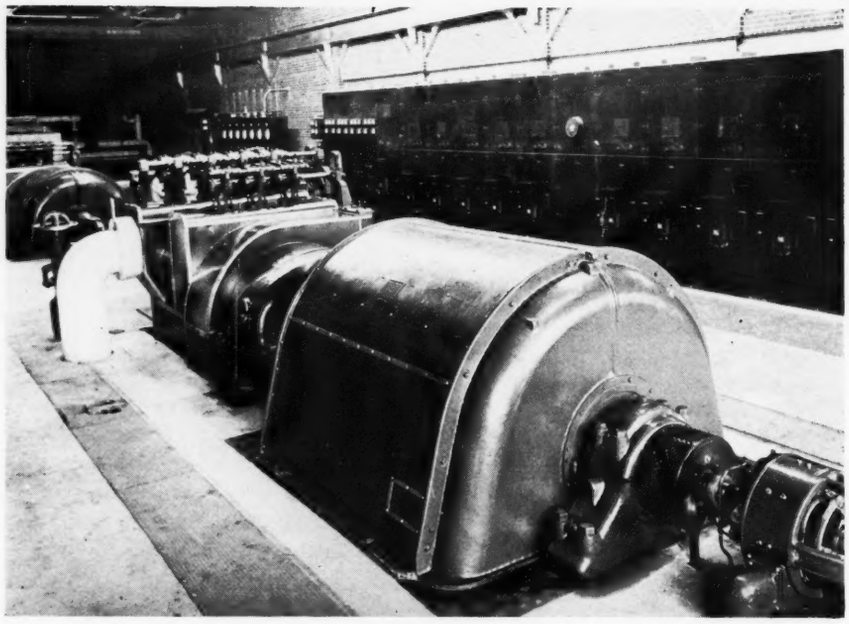
A single-stage open-impeller pump delivers the liquor, about 55% solid and at 220 F, to a nozzle in the furnace front. Designed to spray a sheet of large liquor particles, the nozzle, motor-actuated, moves in an oscillatory cycle to spread the side walls and rear wall evenly. Partly dried liquor particles deposit on these walls and are dried by radiant heat, building up a char foundation. Char lumps break off of their own weight, and fall to the hearth where combustibles burn with primary air injected by nozzles set around the furnace wall, and pointing about 30 deg downward.

Rising products of combustion meet secondary air in the upper part of the furnace and combustion is completed. Passage through hot furnace gas partly dries the liquor particles but the large-particle spray prevents any extensive drying with consequent burning in suspension. Some burning of this kind does occur, however, and the ash, containing chemicals, moves along with the gas stream. Furnace and heating-surface layout produce straight flow with low resistance and minimum opportunity for chemical to collect on surfaces. Chemicals deposited on boiler tubes collect in a dust hopper below and a spray tower at the rear of the unit recovers additional chemical. Molten ash tapped from the smelt spout contains the bulk of chemical recovered.

Construction of a typical Tomlinson unit is shown in the accompanying illustration. Stud tubes form the walls of the completely water-cooled furnace, with full studding below and partial studding above. Three boiler drums parallel the long axis, and are connected by tubes bent at the ends but straight for most of their length. A straight-tube sectional-header boiler can also be used. A parallel-flow welded-element air heater recovers heat from flue gas and economizer equipment may be provided where economically justified. Usual draft equipment comprises one forced-draft and one induced-draft fan per unit, each driven by a single-speed motor, with damper control. The induced-draft fans at St. Joe are equipped with hydraulic couplings.

The drawing also shows arrangement of control and metering equipment common to all Tomlinson units in mills surveyed. Operator controls flow of black liquor manually; this flow and air flow are recorded on a meter so adjusted that fuel-flow and air-flow lines coincide when combustion conditions are correct (at about 25% excess air). Either remote-manual or automatic regulation of forced-draft-damper position maintains this condition. Furnace pressure automatically controls induced-draft-damper position, and a thermo-hydraulic feed regulator completes the control system.

Two double-extraction condensing turbines at St. Joe, with switchboard and distribution-meter panel in background



Turbine Plant

TURBINE-GENERATORS for the new southern Kraft-mill plants are designed to meet operating requirements of close frequency and extraction-pressure control, and of extreme reliability. Of 15 units, totalling 94,125 kva, six (43,125 kva) are double-extraction condensing machines, four (25,625 kva) are single-extraction back-pressure turbines, and the remaining five (25,375 kva) are single-extraction condensing units.

Recent improvements in governing now make it possible to coordinate two extraction pressures and speed. With this arrangement, any change in load or steam requirements in either extraction line will automatically adjust the position of the valve gears to maintain a balanced condition and constant speed. Compensating devices prevent hunting.

In most units a multiple-valve steam chest closely resembling, in valve design and operating mechanism, the chest ahead of the first stage, replaces the multi-port grid valve formerly used. This latter type valve controls flow at the low-pressure extraction point, however.

Ample factors of safety in design enable turbine-generators in these mills to operate continuously at close to full load for long periods with only periodic inspection during short shutdowns in the production schedule. Complete absence of standby equipment demands protection against operating faults and accidents. Protective devices include overload relays, differential protection, and generator-temperature indicators. Generator air coolers and closed cooling circuits keep generator temperature down and air free from dust and dirt, both being essential to operation at full load over extended periods.

Ten of the turbines are equipped with condensers to handle the small quantities of steam not extracted for process use; these range in size from 1000 to 8250 sq ft. Units at Union Bag, West Virginia, National Container, Chesapeake-Camp, and Brunswick take condensing water from nearby rivers; St. Joe's condensers draw on the Gulf of Mexico (St. Joseph's Bay); and wells supply condensing water at Crossett, Champion and Container Corp. Sending warm water from condensers to the mill for process use saves heat units at Crossett, Champion, and Chesapeake-Camp.

Reducers, Desuperheaters

As indicated in the flow diagrams, provision must be made for supplementing extraction flows from the turbines when temporary unbalances between steam and power requirements exist. All plants have, therefore, reducing stations between the boiler-pressure level and the 125–150-lb level, and between the latter and the 35–60-lb level. Additional reducing equipment is installed as required to supply feed heaters and other low-pressure equipment.

To prevent steam flowing into the high-pressure process header at close to boiler temperature, it is customary to install a desuperheater after the reducing-valve euipment. Action of desuperheater is controlled automatically to prevent temperature of steam in process header from exceeding desired limits. Temperature to be maintained can be regulated remotely from the panel board, in some installations.

Under conditions of low load, temperature of steam from the first extraction point might rise above the limit set for the process header. At Union Bag this contingency is provided for by an additional desuperheater designed to operate at a pressure drop of only about 5 lb. A glance at the flow diagrams for Chesapeake-Camp and Champion will show another arrangement which achieves similar results; steam from the reducing valve joins extraction steam and both pass through a single desuperheater.

Only reducing valves are required between high-pressure process header and low-pressure process header. In nearly all cases, reducing valves are equipped with a bypass arrangement to take care of possible failure of valve or control, or to permit maintenance without interruption of service. The bypass may be a globe-valve gate-valve combination or may be an essential duplicate of the regular reducing station, consisting of a reducing valve flanked by gates.

Makeup water required in these mills ranges from 20 to about 35%, with most averaging in the neighborhood of 30%. Chesapeake-Camp, because of joint operation with sawmill, requires about 50% makeup. Union Bag, St. Joe, National Container, Champion, Brunswick, and Container Corp take makeup water from wells; West Virginia and Chesapeake-Camp draw on nearby rivers, and Crossett uses surface water from a pond. Since method of treatment depends on specific water conditions, comparison between plants is more or less useless, but the following summary may be of some interest: four plants use hot-process lime soda as basic treatment with varying supplementary treatments, three use zeolite and supplementary treatment, and two feed phosphate solutions directly into feed lines or drums.

Applying Power

DISTRIBUTION AND APPLICATION of power in the mills surveyed follows best modern industrial practice. Extensive use of metal-clad switchgear, intelligent layout of distribution circuits, and careful selection of motors and drives all contribute to economy and safety of operation.

Universal practice is to generate at 2300 volts, 3 phase, 60 cycles. Main switchboards of cubicle or metal-clad type mount circuit breakers (mostly electrically operated), rheostatic voltage regulators, indicating instruments, and usual protective equipment. Most motors over 50–75 hp operate at 2300 volts; smaller motors take current at 440 volts from a secondary distribution system.

The 440-volt motors can be served in either of two ways: by a single transformer bank, centrally located with feeders radiating to load centers or by several banks of transformers, located near major load centers. Which arrangement is selected in any given case depends on balancing relative cost of transformers, switch-gear, and feeders. At Crossett, the single bank setup was found best; at the other mills, the multi-bank.

Grouped control for both 2300-volt and 440-volt motors features virtually all installations. The right-hand illustration shows a typical distribution center, with two 2300-volt cubicles and numerous 440-volt starters. Each cubicle contains oil circuit breaker and disconnects, with usual protective devices; bus structure runs continuously through the grouped cubicles, completely enclosed. As shown, each 440-volt control consists of a full-voltage magnetic starter with no-fuse circuit breaker, all housed in a metal cabinet. Starters may also be grouped in a common steel cubicle structure.

Advantages of such a distribution center include enclosure of live circuits protected by interlocking doors, convenience of inspection and maintenance, and speed and economy of installation. Remote pushbutton control facilitates operation and promotes safety.

Pulp and paper mills present unusual opportunities for judicious selection of motors and drive equipment because of the wide range of operating conditions encountered. Direct-connected synchronous motors drive the dc generators for paper-machine-drive motors, jordans, and chippers; they meet speed requirements well and make a compact, low-maintenance drive. Since a large part of total motor load is in synchronous units, power factor runs close to unity in most mills, making it possible to take full advantage of kva rating of generators.

General-purpose motors are induction units, direct-connected or belted. For slow speed work, as in conveying machinery, gearmotors find wide application. Most motors in wash room, machine room, and basement are of drip or splash-proof construction, and fully enclosed fan-cooled units meet the dust and fume conditions found in handling lime, for example.

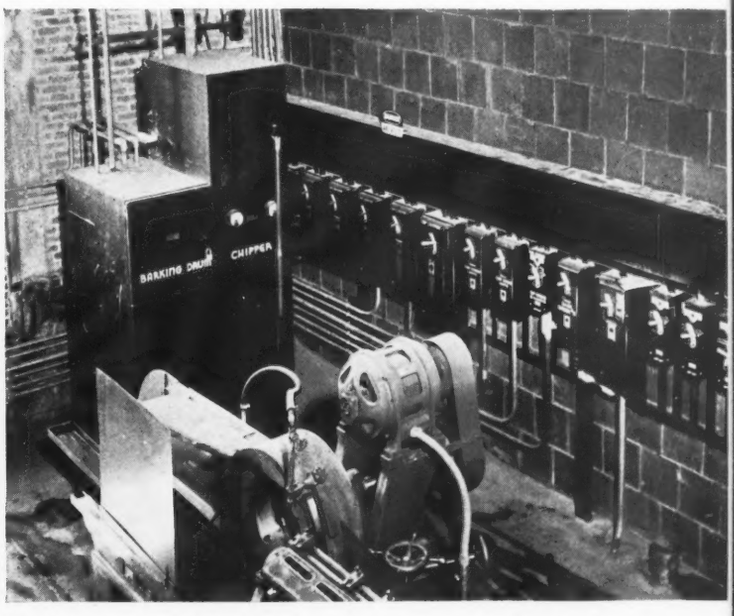
Drives for pulp-drying or paper machines present a highly-specialized and complex problem, since speed at different sections of the machine must be regulated to allow for thinning and lengthening of paper and all the other factors involved in keeping a continuous sheet coming from the machine. The exact means of accomplishing this constitutes a papermaker's problem and it will be sufficient here to merely outline the various methods and how they fit into the power picture.

Sectional Drives

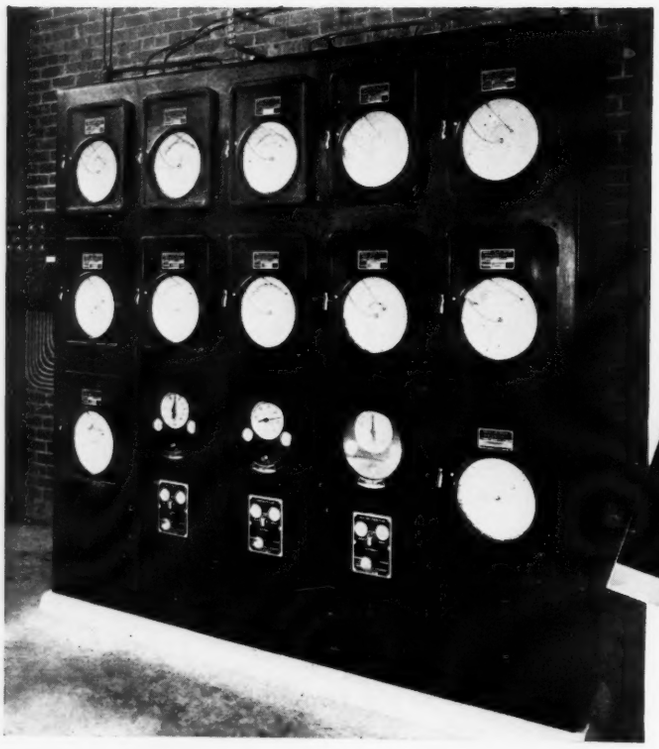
With the exception of Container Corp, all nine mills use sectional electric drives; that is, each section is driven through reducing gear by a variable-voltage dc motor under separate speed control. In the usual arrangement, a dc generator, driven by a synchronous motor, supplies variable-voltage current for motors, at Crossett generator is driven by a steam turbine, which fits into the heat balance.

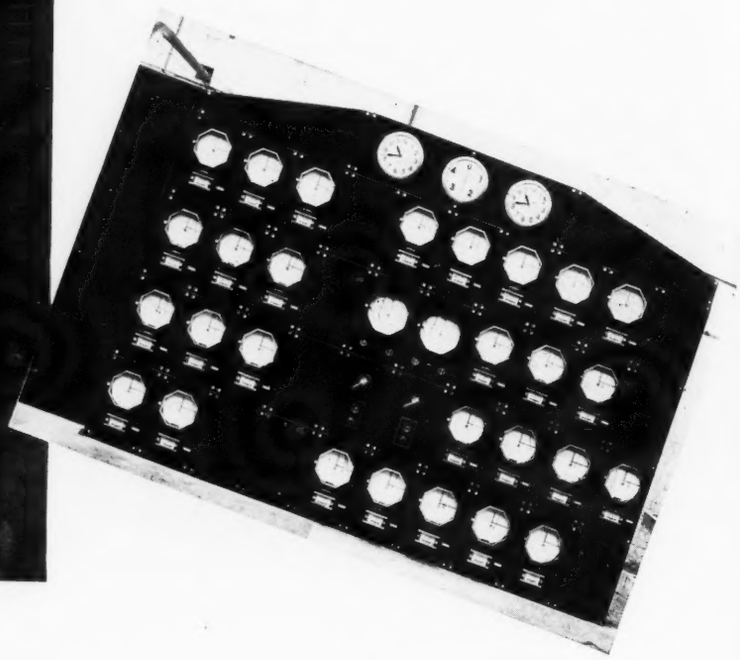
At Container Corp, a single dc motor, mounted on a Rockwood base, drives lineshafting; motor speed is regulated by the adjustable-voltage system. Speed reducers, belted to the line-shaft, drive the individual machine sections. The other major driving system, not employed in any of the mills surveyed, resembles the single-motor system, in that a lineshaft is used, but the shaft is driven by a variable-speed steam turbine.

Sectional electric drive for paper machine at Chesapeake-Camp



Distribution center in chipper room at National Container





Distribution meters and desuperheater controls at Container Corp (left) and Union Bag (below)

Meters, Piping, Buildings

REALIZING FULLY the importance of steam and power in production of pulp and paper, designers have made every effort to provide facilities for economical utilization. Metering equipment for electrical energy, steam, and water is unusually complete and, even more important, it is really put to work in keeping down production cost.

Most mills check electrical output by recording instruments on the main bus and generating units, and follow distribution of energy by watt-hour meters on main feeder circuits. Exact arrangement of recorders for steam and water flows varies, but it is usually considered desirable to meter flow of high-pressure steam to turbine-generators, to steam-driven auxiliaries and to desuperheater. Total steam from each turbine-extraction point is recorded and broken down into flow to major processes and to other uses such as auxiliary drives and feedwater heating. Measuring flow of condensate from turbines and from mill gives part of a picture, which is completed by recording mill- and makeup-water flows. In addition to flow measurements, pressure and temperature records are kept where this data is important in control of the process.

To facilitate chart changing, inspection, and maintenance, meters are concentrated on a single panel where possible. Two such installations are illustrated above; each representing a full complement of recording instruments, and controls for reducers and desuperheaters. A similar centralized distribution metering panel can be seen at the rear of the turbine room, page 82.

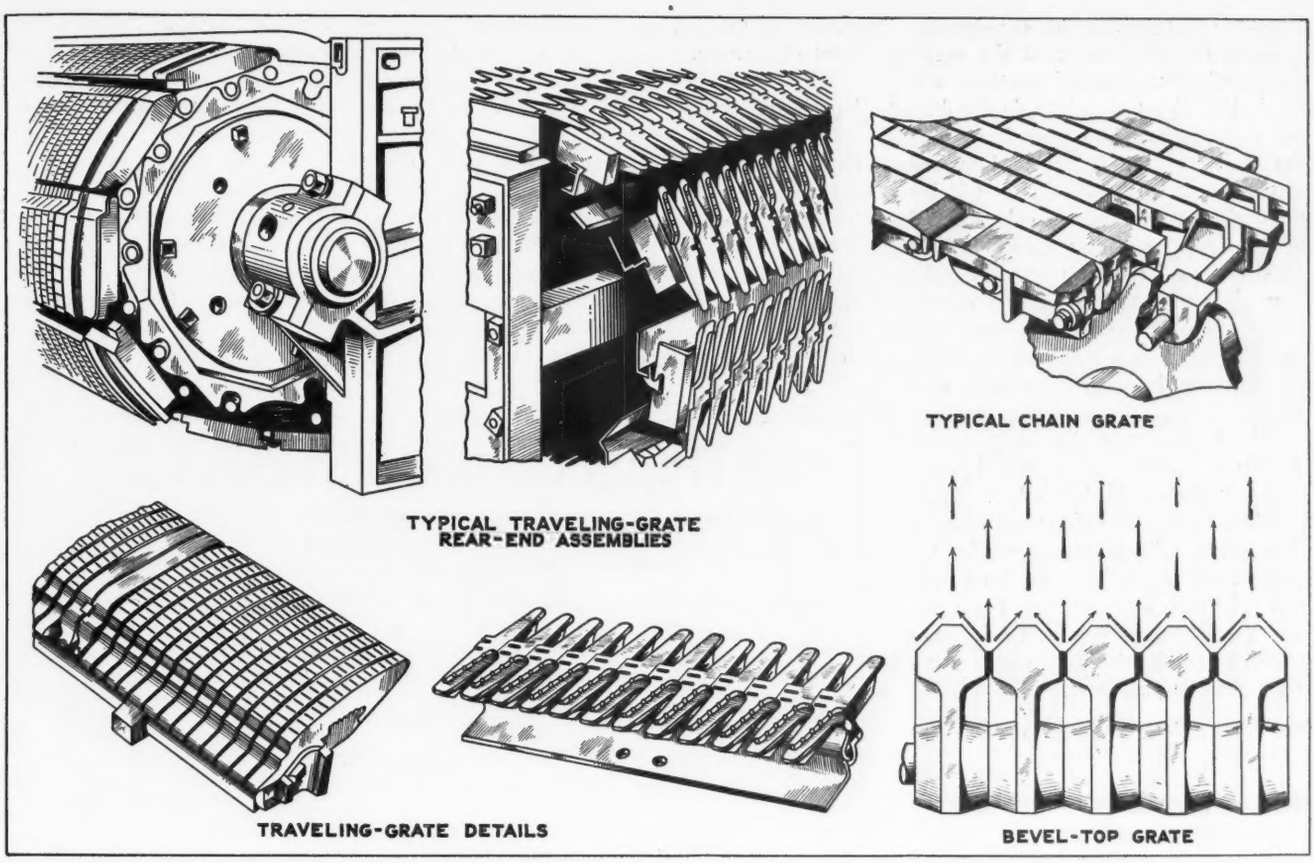
Pipe, Fittings, Valves

From the time the chips are cooked to the time the pulp goes on the machine, the material being processed is liquid, as are most of the materials used in treatment and most of the byproducts. Pipe, fittings, and valves thus constitute a vital link in the process. Unfortunately the scope of this article does not permit doing more than pointing out the problems involved in choice of materials and design of process piping suitable for handling fluids ranging from pure water to alkaline liquors and pulp stock.

Since excessively high pressures and temperatures are not employed in the power plants of these mills, carbon-steel piping will meet all requirements. Welding is universally used on high-pressure steam and feedwater lines and widely used in other piping circuits. Cast- or forged-steel valves and fittings get the call for pressures and temperatures above 250 lb and 450 F, while below this point iron-body brass-trimmed or screwed-end brass valves are installed, depending on size of line.

As might be expected, considerable variation exists between plants in respect to layout and building construction. The power plant is practically an integral part of the mill structure at Union Bag, Container Corp, St. Joe, Crossett and National Container. Main mill buildings in these cases are brick; turbine equipment is in a part of the main building, with boilers and recovery units in an adjoining structure. Where boiler house is built of brick, sheathing one side with corrugated siding provides for expansion.

Separate buildings house power equipment at Chesapeake-Camp, Champion, Brunswick and West Virginia; Chesapeake-Camp and Champion are of brick, Brunswick employs corrugated asbestos-cement siding, and West Virginia combines tile and glass block for the turbine room, and corrugated-protected-metal siding for the boiler house.



Conveyor Stokers

This article, last of a series on construction and application of modern stokers, covers traveling-grate, chain-grate, and compensating-feed units

By L N ROWLEY
Assistant Editor

CONVEYOR STOKERS are units in which fresh fuel reaches the bed from above and in which fuel burns as the bed moves to the rear of the furnace on a flat conveyor-grate surface. In traveling- or chain-grate units, the entire grate surface moves, there is no agitation or compression, and no motion of the fuel bed relative to the grate. In compensating-feed units, alternate traveling and stationary-grate sections apply a combined impelling and retarding force to the fuel bed, placing it under compression, and causing it to move more slowly as it becomes less dense.

Although the terms are generally used interchangeably in everyday practice, there is a real difference between traveling-grate and chain-grate stokers. Traveling grates consist of rows of cast-iron keys or clips mounted on transverse bars attached to continuous chains which travel around the supporting frame. The only connection between adjacent transverse rows of keys is through the two or more chains. Chain-grates differ in that the links making up the surface are staggered and interconnected by pins to form a continuous belt or chain the width of the furnace.

Differences between these two broad types of grate construction can be more clearly seen in the accompanying illustration. Two types of traveling-grate construction are included: in one, grate keys lie side by side, overlapping slightly when in the flat working position; in the other, grate clips are shaped to mesh together when in the flat working position.

These arrangements can be compared with the typical chain-grate surface also illustrated. Three kinds of links—drive, common, and seal—form the chain grate. Drive links are grouped in pairs and spaced in rows according to number of sprockets and width of furnace. Common links fill spaces between drive links; using narrow common links increases proportion of air space between links to total grate surface. Seal links, where used, form a single row on each side of the stoker, and extend over ends of the link rods insuring ample clearance between link rods and guide rails. The bevel-top grate links illustrated increase the portion of the fuel bed under which air is distributed, cutting down dead surface.

In all units links can be replaced without stoker outage and in many cases while stoker runs at normal speed.

Two general types of chain construc-

tion are employed: in one, the sprocket engages the link itself; in the other, the sprocket engages rollers attached to the links. Front sprockets do the driving and are keyed to a shaft running the width of the furnace. Rear-end support arrangements differ widely; the chain may run over sprockets keyed to the shaft, over idler sprockets held on the shaft by collars on each side, over plain pipe rollers, or over curved tracks. To compensate for wear and growth, provision is made for adjusting the distance between front and rear shafts.

Side frames may be built up of machined castings, or structural members bolted or welded together. Cross members are usually structural shapes; they carry skid plates or tracks for support of chain between front and rear shafts. Support for chain on return trip, below, may be tracks, skid plates, or continuous drag plates forming a steel flooring beneath the unit.

Air Distribution

Since the nature of the fuel bed changes as combustion occurs during passage from front to rear, air requirements vary from one end of a traveling or chain-grate stoker to the other. In middle zones where combustion is heaviest most air must be supplied; lesser amounts are needed at front and rear. Dividing the stoker into lateral compartments or zones meets the varying air requirements.

One general method of zoning involves entirely separate compartments, while another uses space between upper and lower chains as a plenum chamber, with dampers to regulate flow through grate surface.

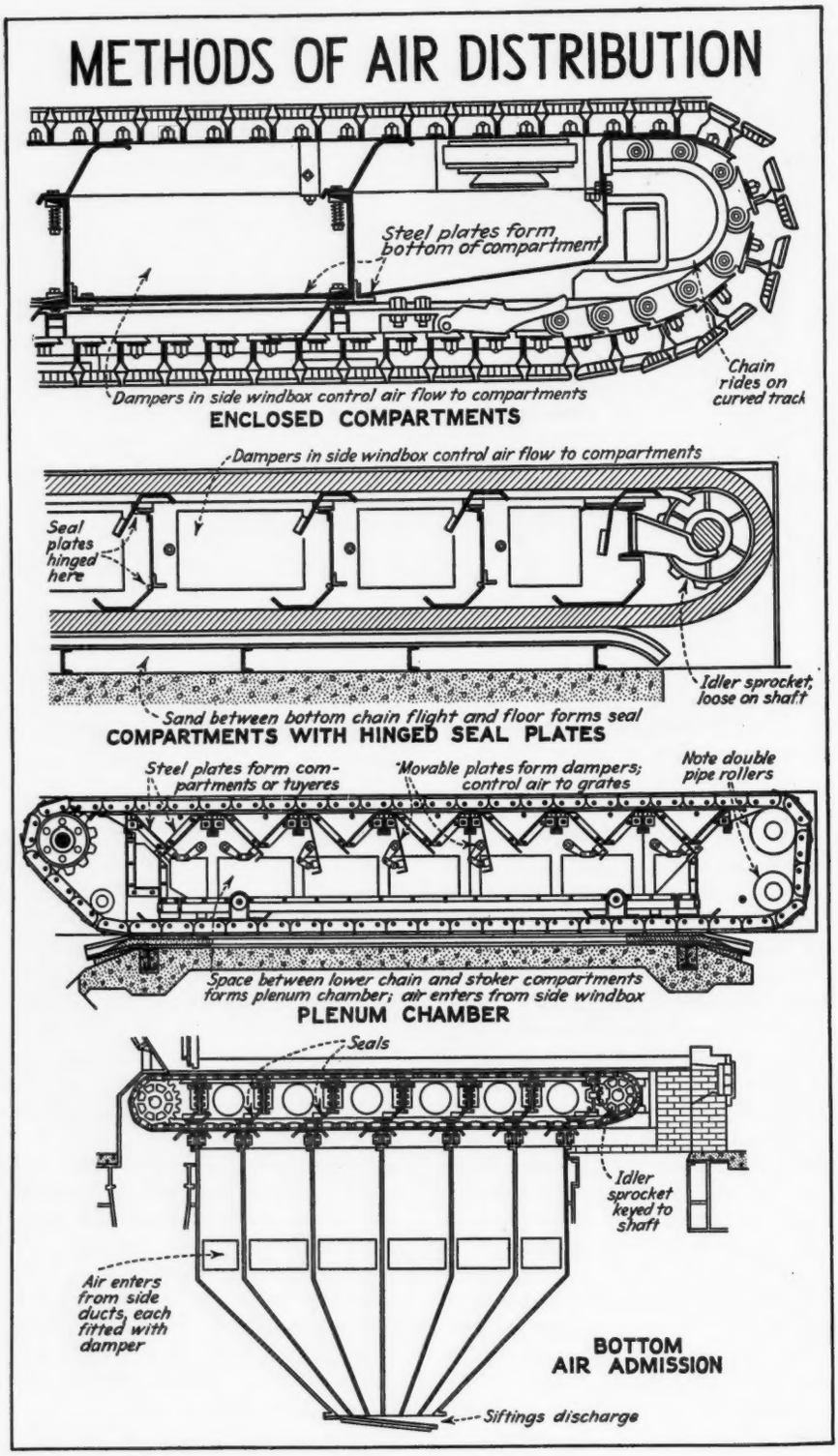
Where compartments are used, cross-members usually form part or all of the compartment sides. The bottom may be formed by a steel plate supported from cross-members; the plate lies between and separates upper and lower grates. In another construction, the compartment is formed by air-seal plates extending down from cross-members to rest on the lower grate. Hinging the seal plates permits passage of broken links or other obstructions. Sealing for the under side of the chain comes from drag plates, if used, or from sand packed between lower chain and floor.

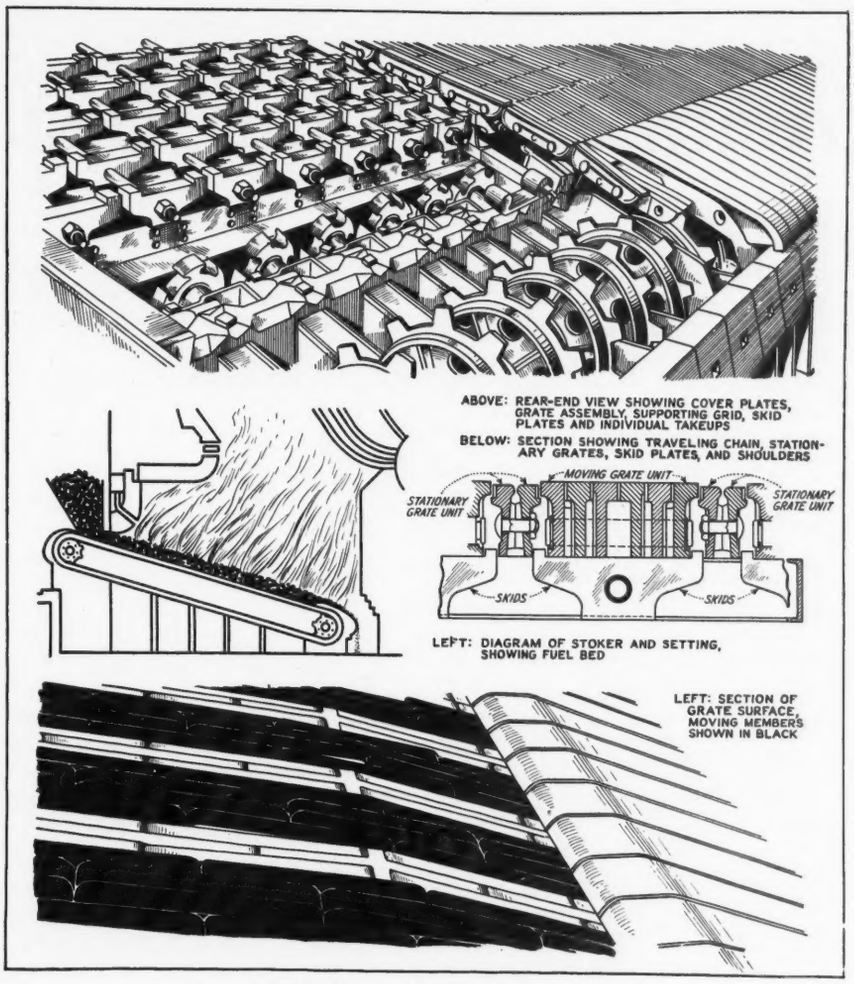
For side air admission, windboxes may be on either side; for stokers more than 7 ft wide, windboxes on both sides give best results. Air from the side windboxes enters the compartments under control of dampers, one at each compartment. Dampers may be sliding or swinging type; control of position may be at side or front of furnace.

For bottom-air admission, the windbox below the stoker is divided into compartments to correspond with those between the stoker grates; flow from main duct to windbox compartments is under control of individual dampers. Bottom admission requires basement space, but air flow past lower grate cools links before return to the furnace.

Compartments are eliminated and the space between upper and lower grates forms a plenum chamber in another unit. Air enters from a side windbox and a series of transverse steel plates set at an angle of 45 deg. regulate flow through grates. Each pair consists of one fixed and one movable plate; controlling position of the movable plate regulates air flow to each zone. In smaller stokers using this general arrangement, a single damper plate in each zone controls flow.

Most of the foregoing applies to


METHODS OF AIR DISTRIBUTION
Steel plates form bottom of compartment
Chain rides on curved track
Dampers in side windbox control air flow to compartments
ENCLOSED COMPARTMENTS
Dampers in side windbox control air flow to compartments
Seal plates hinged here
Idler sprocket, loose on shaft
Sand between bottom chain flight and floor forms seal
COMPARTMENTS WITH HINGED SEAL PLATES
Steel plates form compartments or tuyeres
Movable plates form dampers; control air to grates
Note double pipe rollers
Space between lower chain and stoker compartments forms plenum chamber; air enters from side windbox
PLENUM CHAMBER
Seals
Idler sprocket keyed to shaft
Air enters from side ducts, each fitted with damper
BOTTOM AIR ADMISSION
Siftings discharge


ABOVE: REAR-END VIEW SHOWING COVER PLATES, GRATE ASSEMBLY, SUPPORTING GRID, SKID PLATES AND INDIVIDUAL TAKEUPS
BELOW: SECTION SHOWING TRAVELING CHAIN, STATIONARY GRATES, SKID PLATES, AND SHOULDERS
MOVING GRATE UNIT
STATIONARY GRATE UNIT
STATIONARY GRATE UNIT
SKIDS
SKIDS
LEFT: DIAGRAM OF STOKER AND SETTING, SHOWING FUEL BED
LEFT: SECTION OF GRATE SURFACE, MOVING MEMBERS SHOWN IN BLACK

Details of compensating-feed stoker

forced-draft operation, which is necessary for high burning rates. However, many of the forced-draft stokers can be operated under natural draft at light loads and several manufacturers build units specifically for natural draft.

Preheating air helps burn low-grade fuels, particularly those high in moisture, but its use increases grate temperatures and may increase grate maintenance unless grates are designed for such conditions. Most traveling-grate and chain-grate stokers can be operated successfully with preheated air. Temperatures as high as 500 F have been reported. On one stoker, an air chamber immediately behind the front sprockets provides for cooling grate links when operating with preheated air. A small fan draws air from the boiler room over the heated links before they return to the furnace.

Traveling-grate and chain-grate stokers are commonly used to handle small-particle fuels. Grates are designed to reduce siftings, but a small mount of dust, fines and ash will drop through the grates and must be removed. In stokers where air compartments have steel-plate bottoms, access doors permit removal by hand, or steam-jet arrangements blow them out. On other units, siftings drop through on the lower chain; small particles go through to the sand-packed space below the lower chain, coarse particles are carried to the front by the chain. Where drag plates seal under side of the lower chain, siftings move forward on the chain. Divided windbox used in bottom-admission stokers is fitted with hoppers into which siftings drop.

Grate travel averages about 25-30 ft per hour or about 2—2.5 times stoker length, in feet per hour. All traveling-grate and chain-grate units require an integral speed-reduction unit; this may be a single or double worm-and-wheel combination, or spur gearing with final reduction by worm and wheel. The speed shaft of the reducer can be driven by any conventional driving mechanism. All units have shear pins or similar devices to protect against jamming caused by broken links or other obstruction.

Better understanding of combustion principles has changed design of furnaces for traveling- and chain-grate stokers. Usual furnace has both front and rear arches and may have a narrow throat between arches. Front arch, of course, helps maintain ignition and originally this function was considered so important that extremely long front arches were employed. Modern practice favors the long rear arch which directs gas from the rapidly burning portion of the fuel bed at the rear to the front of the furnace, promoting turbulence and thorough mixing of rich and lean gas. Particles of burning fuel carried forward help maintain ignition. Exact disposition of arches depends on kind of fuel to be burned, operating conditions, design of boiler, and space available.

One stoker uses a mechanical-ignition system for burning high-moisture fuels. A suction compartment directly under the feed gate draws small quantities of hot furnace gas through the incoming green fuel, insuring ignition.

Standard traveling and chain-gate stokers are built with grate areas ranging from around 25 sq ft to over 600 sq ft. For smaller boilers there is a stoker-boiler unit, sold under single responsibility, rated at from 150 to 2000 sq ft of boiler surface.

With forced draft, burning rates average 20-35 lb of anthracite per sq ft per hr or 30-50 lb of bituminous per sq ft per hr. Maximum rates for anthracite run around 50 lb per sq ft per hr, and for bituminous around 70. Heat release should not exceed 50,000 Btu per cu ft per hr for good practice.

Traveling-grate and chain-grate stokers will burn almost any free-burning fuel including non-coking bituminous, anthracite, lignite, coke breeze. They are particularly well suited to handling small sizes of anthracite such as culm and river coal. It is advisable to keep ash content above 6% for protection of grates.

Compensating Feed

The accompanying panel shows diagrammatic arrangement of a compensating-feed stoker and setting, and details of construction. Side and center frames (possible because of use of stationary grate members) support a series of channel bars spaced on 6-in. centers from rear-end assembly to dead plate. Cast-iron skid plates fitted to these bars provide surfaces on which traveling grate sections slide.

Stationary sections, made up of cast-iron segments, are secured to the cover plates of the rear-end assembly and extend full length of stoker to the dead plate; front end is free, which allows for cast-iron growth. Somewhat similar segments form traveling chains, but

(Continued on page 152)

How to Select and Install

TIME LAG is an important factor which may introduce an error in a thermometer reading unless reasonable care is taken. Saying that a thermometer has time lag is only another way of stating that it takes time to heat or cool a thermometer bulb from one temperature to another. For example, consider a bulb that has been in ice water long enough to read the correct temperature of 32 F and is then suddenly transferred to boiling water. The thermometer will not immediately read 212 F. The mercury will rise very rapidly at first, but the nearer the reading comes to 212 the slower will be the increase. In fact, it may take several minutes for the reading to become approximately 212 F.

The rate at which the bulb is heated under these conditions can be determined by taking successive readings timed with a stop watch. A heating curve of a thermometer bulb looks like Fig. 1. Note how rapidly the curve rises at first, but how it flattens out as it approaches the final temperature, almost as though it were trying to avoid the meeting. The curve is a typical heating curve. It follows the same thermodynamic laws which govern heat-exchangers, change in temperature being a logarithmic function of time.

Operating Conditions

Operating conditions, however, may not be quite so simple as in the example. Suppose the bulb is in a fluid which itself is being rapidly heated or cooled. The bulb temperature will lag even after the actual temperature has become constant. Assume, that in the example, the water went through a rapid and continual temperature cycle of heating and cooling, between 32 and 212 F. Because of lag, the thermometer would never read as high as 212, nor as low as 32 F, and the bulb temperature would never get in phase with the actual temperature. The thermometer reading, however, would be correct twice during each cycle. This would happen once when the actual temperature had reversed and was on the way down, and crossed the bulb temperature which was still on the way up. A correct reading would also be obtained once when the actual temperature had reversed and was on the way up, and the bulb temperature was still on the way down. Obviously under conditions of rapid and wide fluctuations of temperatures, the indications of a thermometer will be of little value unless its lag is known, and the reading corrected.

Fig. 1 shows that under the specified conditions it takes the thermometer about 24 sec to read 210 F, which is an approach within 2 deg of the correct temperature. In general, it is true that the thermometer reading should not be taken until after an elapsed time of about 4 times the lag. In Fig 1, lag is 6 sec.

Thermometer Readings

When the lag for any thermometer is determined for a given set of conditions, a curve similar to Fig. 1 can be constructed, either by calculation or by active test readings. This curve can then be used to help approximate the correct temperature when readings must be taken while the temperature is fluctuating, increasing or decreasing. The best way to read a thermometer, however, is to wait until it has approached equilibrium, and steadied down.

It is well known that a thermometer may be much faster in some fluids than in others. For instance, a thermometer in water may be 15 times faster than in oil, for the same degree of agitaton. Likewise, the bulb in water may be as much as 100 times faster than in still air. Even in water, the thermometer will be much faster if the water is agitated. Thus, time lag for any thermometer will be determined by the fluid in which the bulb is immersed, and by the degree of circulation of the fluid past the bulb. The lag will also depend on the shape of the bulb. It will be greater for a spherical bulb than for a cylindrical one, and will be less for a bulb of small diameter. In general, the bulb volume should be small in relation to the surface area of the bulb.

Natural lag of an industrial thermometer is increased by the metal bulb chamber. Lag effect of the bulb chamber can be reduced by using a good heat conductor in the space between the glass bulb and the chamber. Mercury is excellent for this

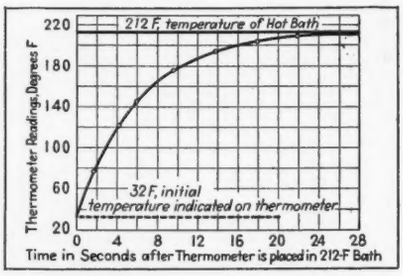


Fig. 1—Heating curve of a thermometer having 6-sec lag

purpose, but cannot be used for temperatures higher than its boiling point, 630 F. For higher temperatures, a mixture of oil and graphite is better than plain graphite. For temperatures above 500 or 600 F, a molten metal such as tin, which melts at 450 F, is sometimes used.

Separable sockets quite often are necessary, but they further increase the lag. Here again, the lag can be reduced by using a heat conductor between the chamber and socket. Or the bulb chamber and socket may have a slight taper to insure metal to metal contact and thus give heat transfer. The more important points of thermometer lag may be summarized as:

1. Do not read a thermometer while the reading is changing rapidly, unless the thermometer lag is known for the actual operating conditions.
2. Remember that the lag of a thermometer will be different for different fluids, and for different degrees of agitation, or circulation of the fluid past the bulb.
3. Lag will be small in water, longer in oil, and quite long in air.
4. Lag in superheated steam will be much longer than for wet or saturated steam, for the same velocity of flow past the bulb.
5. Lag of a thermometer in a given fluid can be determined by a very simple time-temperature test.

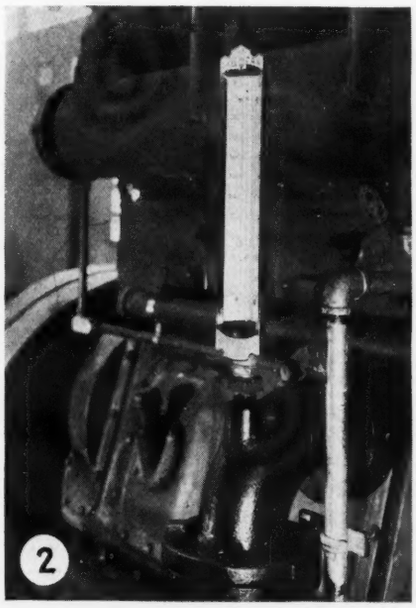
Bulb Materials

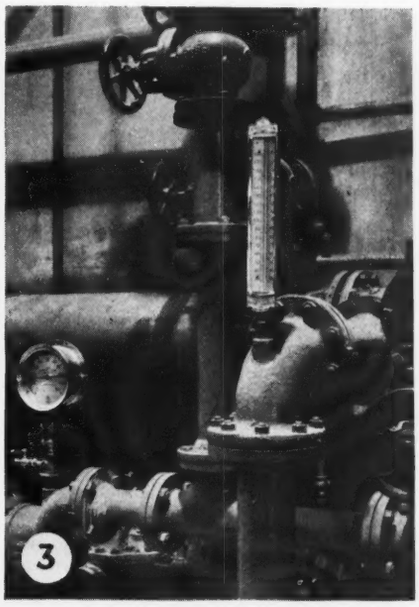
There are many corrosion-resistant materials from which the chamber or socket can be made. Unfortunately, however, corrosion still causes considerable trouble, much of which could be avoided by merely specifying the service, and the fluid in which the bulb is to be submerged. For example, if

Industrial Thermometers

By proper installation, compensating for and reducing lag, and clear specifications to manufacturers, industrial users can get most for their thermometer dollar

By E H HAMMOND
Chief Engineer, American S & B Division
Manning, Maxwell & Moore, Inc





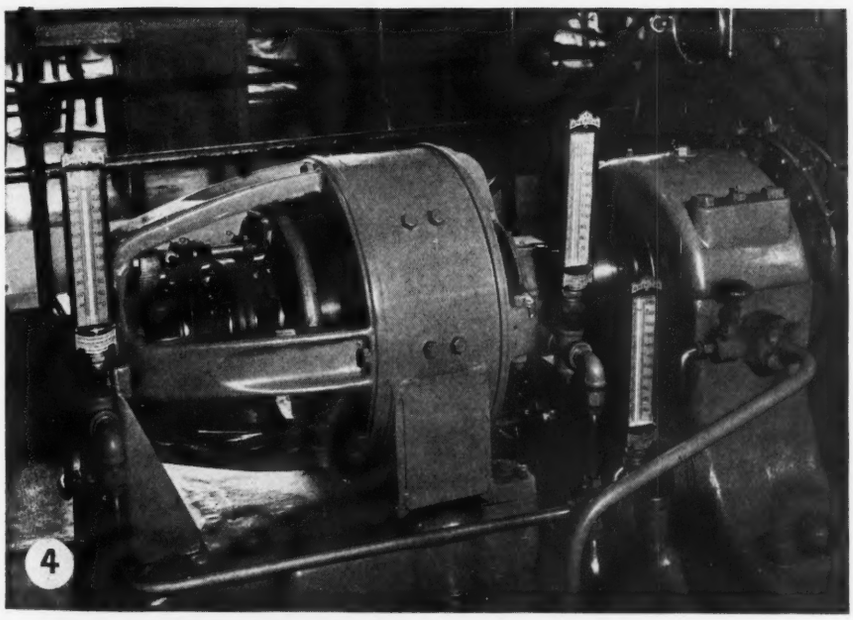


Fig. 2—Industrial thermometer on jacket-water line of a large gas engine. Fig. 3—Industrial thermometer measures temperature of cooling water to gas-engine jacket-water cooler. Fig. 4—Three thermometers indicate temperature of lubricating oil from bearings of turbine-generator and exciter

it is known that a vessel must be of a certain material to withstand corrosion, then if possible the thermometer chamber or socket should be specified of the same material. Also, the bulb and socket material should be selected to prevent electrolytic action with the walls or other parts of the vessel.

Bulbs should not be installed where velocity of flow will be so great as to cause undue vibration, shock, or erosion. Neither should the bulb be installed in a dead zone, or where the temperature is not representative. A good thermometer may be useless in service because of improper installation. The proper location, and the distance the bulb should project into the pipe or vessel are important engineering considerations which will have much bearing on the accuracy and satisfaction obtained from the thermometer. Do not install a thermometer where the case will be subject to severe physical or mechanical abuse. A thermometer tubing can be broken, even though it is protected by the case and glass front.

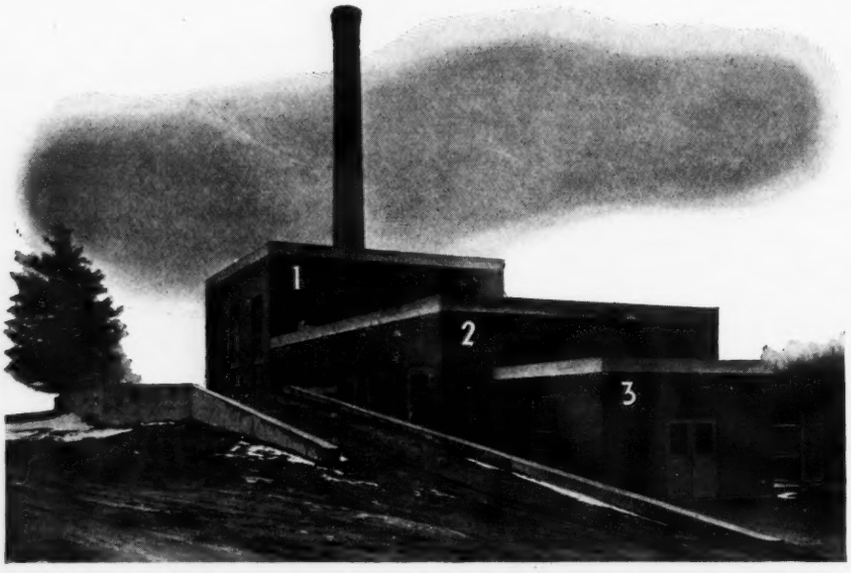
How to Purchase

Finally, do not purchase a mercury-in-glass thermometer if a dial thermometer would be better suited for the service. See POWER, August, September, October, November, 1937, and January, 1938.

Good industrial thermometers are made to order. The following information will help the manufacturer build for you the proper thermometer for your requirements:

1. Size (length of scale).
2. Range, and whether Fahrenheit, Centigrade or Reaumur.
3. Normal working temperature, and maximum working temperature.
4. Connection, rigid, union or separable socket.
5. Case, straight, back, left or right angle; reclining or inclining.
6. Size of connection, N.P.T. (¾ in. standard).
7. Length of bulb and stem, including thread.
8. In what fluid will the thermometer be used.
9. Of what metal is the wall of the container.
10. Any other special information.

A Small Plant Saves



White-Haven Sanatorium builds new 200-kw plant on site of old one and changes power system from dc to ac without interrupting service. Coal consumption is reduced from 12 to 9 tons per day

Fig. 1—Building 1, boiler plant; building 2 houses power units and boiler-auxiliary equipment; building 3, work shop, feedwater laboratory and sanitary facilities; driveway in foreground leads onto coal bunker

WHITE HAVEN SANATORIUM, perched on a mountain overlooking White Haven, about 30 miles south of Wilkes-Barre, Pa., provides accommodations for 250 tuberculosis patients and the required operating staff. This institution, comprising about forty buildings, a milk-pasteurization plant, cold-storage plant, a large laundry, green-houses and chicken farm, is supplied with power, light and heat from a power plant at the foot of the mountain, about ½ mile away from the main buildings.

In 1937, the power plant, about 30 years old, consisted of two 100-kw engine-driven 220-volt dc generators; one stoker-fired, two hand-fired hrt boilers and a hand-fired water-tube boiler. This equipment was housed in what amounted to four different buildings. One engine, the stoker-fired boiler, coal storage under a railway trestle and the work shops were all in wood buildings of shed construction. The other two buildings had substantial brick walls with wood roofs.

All equipment and buildings were in very poor condition when Henry F Sanville and Charles E Bonnine, consulting engineers, were retained to study and report on how the plant could be made serviceable. The boiler plants, including feed pumps and heaters, were in such condition that they had to be scrapped. The boilers were operating on practically 100% make-up, condensate from the large heating load not being returned to the plant. All power was distributed at 220 volts which made it impossible to use standard 120-volt electrical equipment. This made the purchase of electrical supplies both costly and inconvenient. The long distance that power had to be transmitted at 220 volts caused large losses and poor voltage regulation. Also, the old dc lines were in poor condition and needed rebuilding.

The consulting engineers recommended putting in a complete new boiler plant and stack with coal-storage and auxiliary equipment, a new service-water pump and air compressor; conditioning and relocating the engines plus adding new ac generators; changing the dc system and equipment for ac operation; installing a line to return all condensate to the power plant; arranging new equipment and reconstructing buildings to provide a modern economical installation. The sanatorium, a philanthropic institution, did not have sufficient funds available to completely rehabilitate the plant, but through the generosity of Pierre S du Pont, this difficulty was overcome.

Plans and specifications were made by the consulting engineers and a contract for the construction work was awarded, by competitive bidding, to the Beaver Construction Co, all work to be done without interrupting any power-plant services.

Mechanical coal-handling equipment,

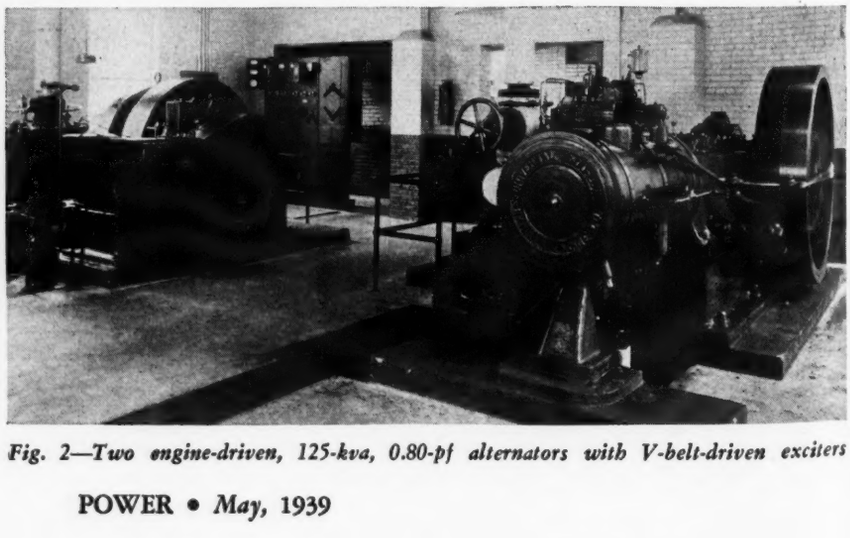


Fig. 2—Two engine-driven, 125-kva, 0.80-pf alternators with V-belt-driven exciters

automatic stoker or pulverized-coal-fired boilers, extensive use of meters and records and other refinements of power-plant design have become so commonplace that engineers are inclined to forget that simpler plants are still justified on economic grounds, the case at White Haven.

This power plant is small, in a somewhat isolated district supplying services to a hospital; therefore, it must be 100% reliable. To attain this end, simple substantial design is very important. Being in the anthracite-coal region, fuel is cheap and all power is generated as a byproduct from heating steam. Consequently, steam and power costs will be low in a well-operated plant of simple design. It was with these facts in mind that the new plant was designed.

The old steam conditions were 125 lb g, saturated. Because all exhaust steam is used for heating throughout the year, these steam conditions were selected for the new plant. Two boilers designed for a maximum working pressure of 160 lb g, with their safety valves set for 125 lb, were selected. They are of 3-drum, bent-tube type, Fig. 4, of 3012 sq ft of heating surface each, with the centerline of the mud drum set 10 ft above the operating floor. This setting places the nearest tubes 9 ft above the grates and gives a furnace volume of 650 cu ft.

Stokers

Forced-draft hand-operated stokers, guaranteed to produce 15,000 lb of steam per hr when burning barley-size anthracite coal, and with a projected grate area of 72 sq ft, were selected. They are equipped with 2500-lb-capacity coal hoppers and are simple in construction, reliable, easily fired and maintained. The grates, 8 ft 6 in. by 8 ft 6 in., are divided into 6 sections, each of which can be cleaned separately.

Automatic combustion control, soot blowers, automatic feedwater regulators and 3-pointer draft gages have been provided. Because of the low cost of fuel, the engineers did not believe that a more complete meter installation was justified. Furthermore, the meters would have to be maintained, which might not have been an easy problem in this plant.

Contour of the land around the plant is such that an inclosed 400-ton coal-storage with ramps could be built adjacent to the front of the boilers. Coal is received by trucks that drive on top of the storage building and dump through the roof. From storage, coal is shoveled into a bottom-dump car of about 1000-lb capacity, wheeled into the boiler room, lifted by a mono-rail electric hoist and dumped into the stoker hopper. This arrangement makes a simple and reliable coal-handling system from which a large part of the hard work has been eliminated.

The dividing wall between the old brick boiler room and engine room was removed and the single room roofed with fireproof material. All boiler-auxiliary equipment was installed in the old boiler room. This included a new feedwater heater directly above the boiler-feed pumps and an elevated storage tank into which all condensate is returned and into which makeup water flows.

On the floor below the storage tank are two booster feed pumps that discharge water from the tank into the feedwater heater. This section of the plant also contains a small air compressor and the higher-pressure service-water pump. In the other section of the old plant are now installed the two engine-driven alternators. The old building which housed the Ames-engine-driven generator has been removed and a new building erected for a work shop, a feedwater-testing laboratory and toilet facilities. The old wooden work shop has also been removed.

Many rebuilt plants show evidence of an upheaval. This job, however, has been handled so skillfully that it has all the appearance of an entirely new plant, Figs. 1, 2 and 3. It is well-lighted and ventilated with plenty of room to work around the equipment. All metal work, including the steel casings around the boiler settings, has been painted with aluminum paint, which in combination with the white heat insulation, gives the plant a very clean and cheerful appearance, a place that operators want to work in and keep clean.

The entire change-over was made without interrupting either steam or electric power service from the plant. First operation was to remove the old stoker-fired boiler. On this site, two new boilers in a new brick building were put. Just outside this building, a new radial-brick stack 100 ft high and 5 ft inside diameter at the top was erected. While this work was being done, part of the old coal-storage building and trestle was removed and a section of the new coal storage built adjacent to the new boiler plant.

When the boilers were ready for service, they were connected by a temporary line into the old steam line in the engine room, to operate the plant. Then the other three old boilers were removed, the wall between the old

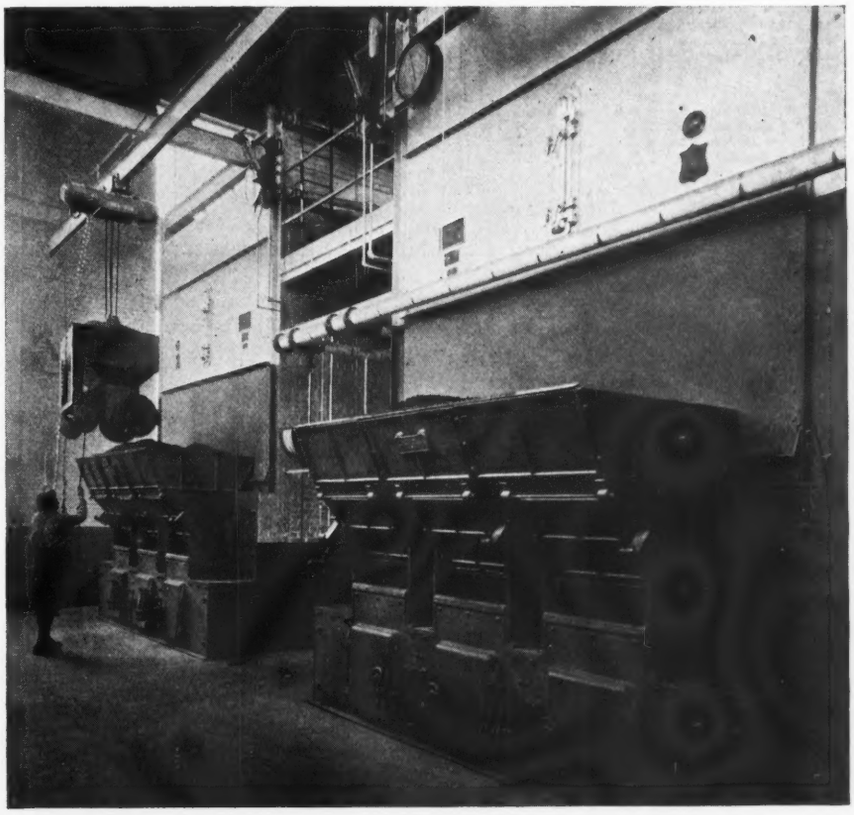


Fig. 3—Two 3000-sq-ft, 125-lb pressure, hand-stoker-fired units burn barley anthracite

Principal New Power-Plant Equipment

WHITE HAVEN SANATORIUM, WHITE HAVEN, PA.

Boiler equipment:

Boilers, two, 3-drum, bent-tube, 3012 sq ft of heating surface,, baffled for 3 passes, rated continuous capacity 15,000 lb per hr; designed steam conditions, 160 lb of saturated; operating steam conditions 125 lb saturated ..... Babcock & Wilcox Co
Boiler settings ..... Rust Engineering Co
Stack, radial brick, 100 ft high 5 ft inside dia. at top ..... Alphons Custodis Chimney Const Co
Breeching ..... Heilman Boiler Works
Stokers, hand operated, Dean dump-grate type, 72 sq ft projected grate area ..... Washburn & Granger Co
Forced-draft fans, turbine-driven ..... Coppus Engineering Corp
Feedwater regulators (Copes) ..... Northern Equipment Co
Safety valves (Consolidated) ..... Manning, Maxwell & Moore
Non-return valves ..... Elliott Co
Blowoff valves ..... Yarnall-Waring Co
Blowoff tank ..... Quaker City Iron Works
Soot blowers ..... Vulcan Soot Blower Co
Combustion control ..... Hagan Corp
Water columns ..... Reliance Gauge Column Co
Draft gages ..... Hays Corp
Steam-pressure gages (Ashcroft) ..... Manning, Maxwell & Moore
Coal buggy ..... Easton Car Co
Electrically operated coal hoist ..... Shaw-Box Crane & Hoist Co

Feedwater system:

Feedwater pumps, 2 ..... Warren Steam Pump Co
Booster feed pumps, 2 ..... Warren Steam Pump Co
Feed-pump governors ..... Davis Regulator Co
Feedwater heater ..... Elliott Co
Feedwater storage tank ..... Quaker City Iron Works

Piping and valves:

Wrought-iron pipe ..... A M Byers Co
Steel pipe ..... Spang-Chalfant Co
Brass pipe (Anaconda) ..... American Brass Co
Pipe hangers ..... Sherman Pipe Hanger Co
Pipe heat insulation ..... Johns-Manville
Gate valves ..... Jenkins Bros
Globe valves ..... Jenkins Bros
Check valves ..... Jenkins Bros
Relief valves ..... J E Lonergan Co
Backpressure valves ..... Schade Valve Mfg Co
Float valves ..... Davis Regulator Co
Traps ..... Warren Webster & Co
Strainers ..... Warren Webster & Co
Exhaust heads ..... Swartwout Co
Steam separators ..... Elliott Co
Oil separators ..... Elliott Co
Piping Contractor ..... John Borden & Co

Electrical equipment:

Alternators, 2, 125 kva, 0.80 pf, 240 volts, 60-cycles, 3 phase with 7.5-kw 125-volt exciters ..... Westinghouse Elec & Mfg Co
Switchboard ..... Westinghouse Elec & Mfg Co
Transformers ..... Pennsylvania Transformer Co
Underground cable ..... Okonite Co
Storage battery emergency lighting equipment ..... Electric Storage Battery Co
Electrical Contractor ..... Woodfield-Thompson Co

Other equipment:

Lubrication equipment ..... Amco Corp
Unit heaters ..... Carrier Corp
Service-water pump ..... Aldrich Pump Co
Service-water pump motor ..... Westinghouse Elec & Mfg Co
Air compressor ..... Pennsylvania Pump & Compressor Co
Air-compressor motor ..... Westinghouse Elec & Mfg Co

boiler and engine rooms removed, and a fireproof roof installed. Next, new auxiliary equipment for the new boilers, the new service-water pump and air compressor went in. A new pipeline to return condensate from all the buildings to the power house and connected into the feedwater storage tank, and a new high-pressure pipeline between the buildings and power house, were installed.

While this work was being done, remainder of the old coal trestle was removed and the new coal storage completed. The old service-water pump and air compressors were removed to temporary locations in the engine room to permit putting in a foundation for the Ames engine across the room from the Skinner engine. When the Ames engine was dismantled, its crankshaft was sent to the Westinghouse shops for installation of a new ac-generator rotor. A dead-front switchboard for two new ac generators and distribution lines, the step-up transformer bank at the power house and the step-down transformer banks at the sanatorium, were installed and connected by underground cable.

With the new generator in service, both ac and dc were available and the power services were gradually changed over. The new service-water pump and air compressor were put into service and all the old equipment removed from the engine room. When the dc load had been transferred to the ac system, the Skinner engine was installed on a new foundation, its generator changed and the job completed.

The ac generators are rated 125 kva, 0.80 pf, 240 volts and have 7.5-kw, 125-volt exciters. A generator voltage of 240 volts was selected so that all high voltage could be kept out of the power house. For transmission to the sanatorium, power is taken through a bank of three 37.5-kva, 240- to 2400-volt transformers just outside the power plant.

The plant has now been in operation for several months in charge of William Dodson, chief engineer. It has proved easy to operate, has met the engineers' expectations and has reduced coal consumption from an average of 12 tons per day to 9 tons.

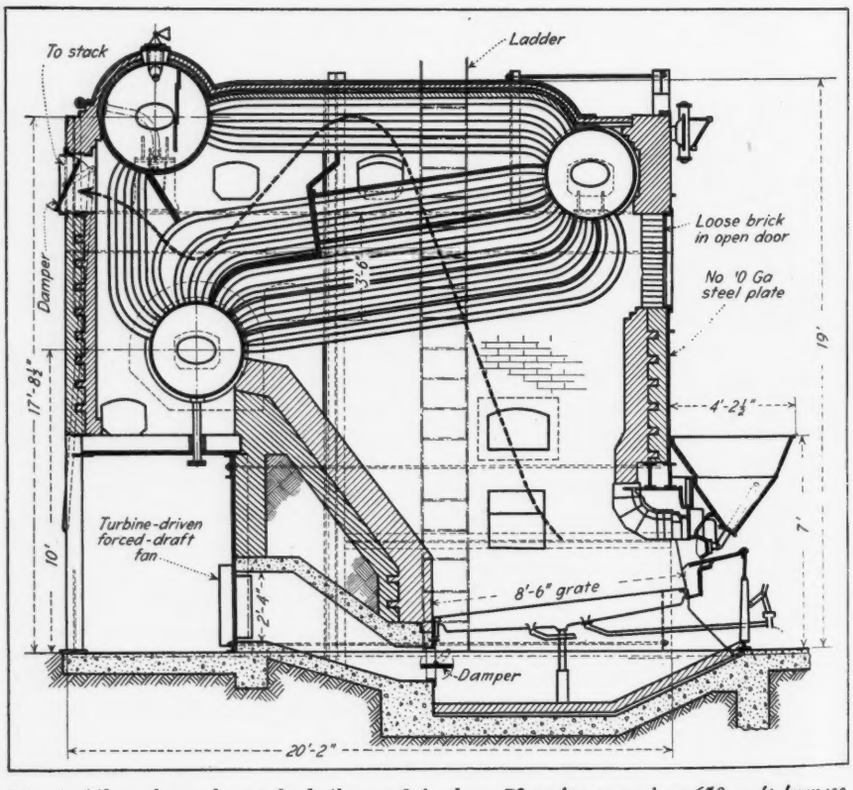
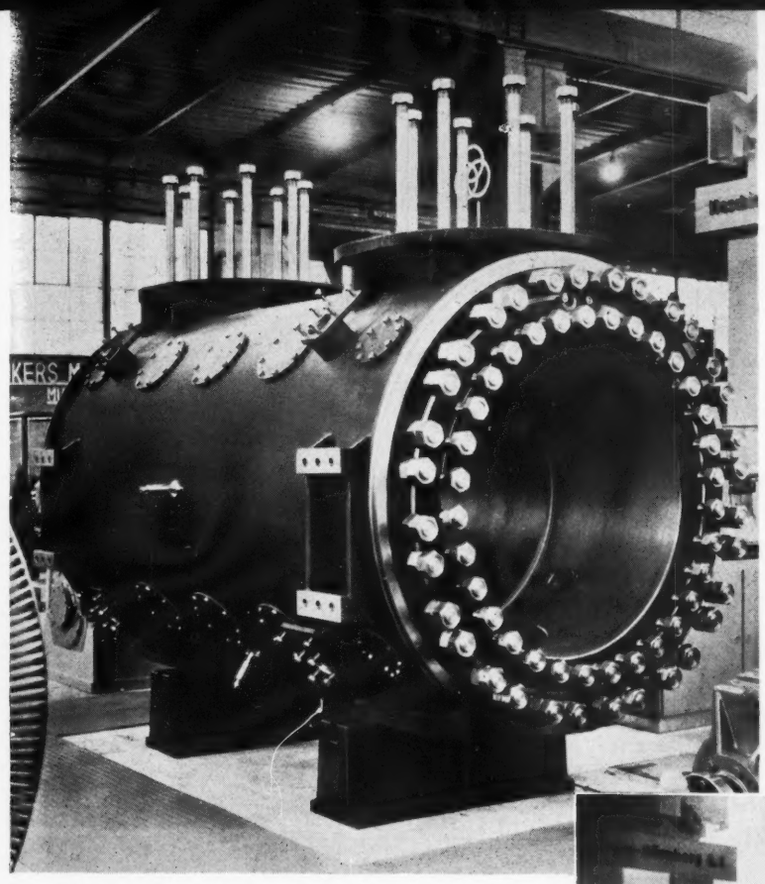


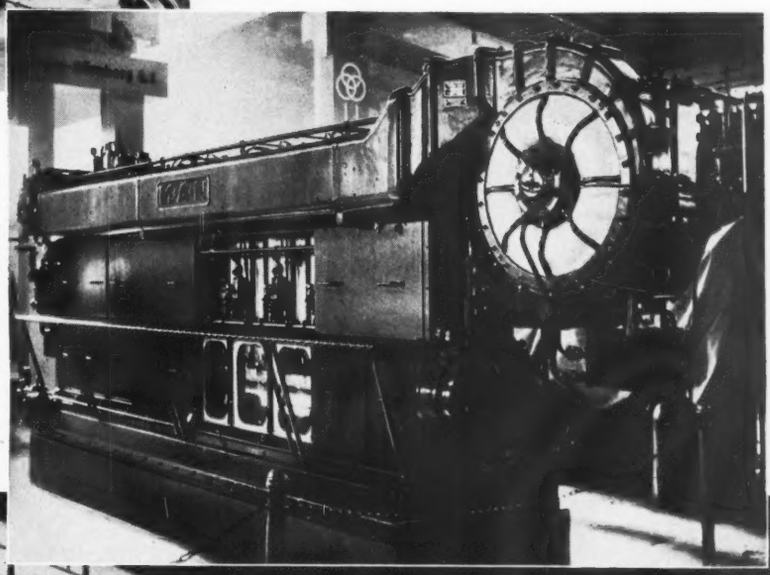
Fig. 4—Three-drum, bent-tube boiler set 9 ft above 72-sq-ft grate gives 650-cu-ft furnace volume, permits operating boilers at 150% rating

Leipzig Goes Diesel

Internal-combustion engines again grabbed the lion's share of attention at the annual Leipzig Trade Fair, held March, 1939



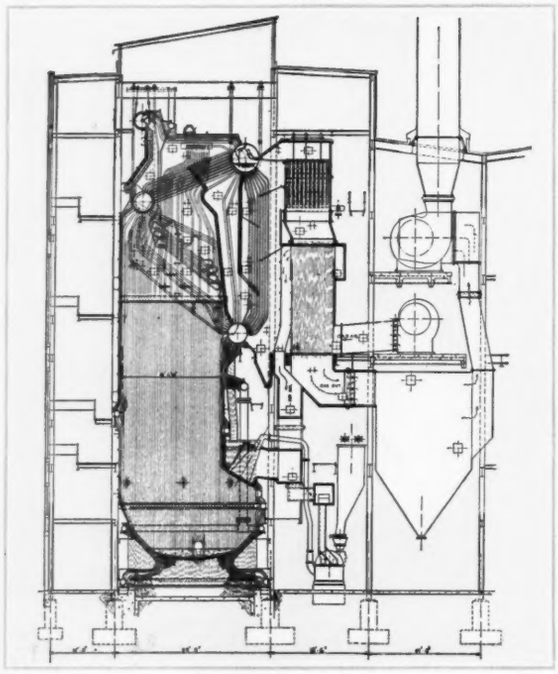
Welded-steel cylinder, with shrunk-in cast-iron liner, for a M.A.N. gas engine, 1250 bhp per cyl. Bore is about 50 in.; stroke, 52 in.; speed, 94 rpm



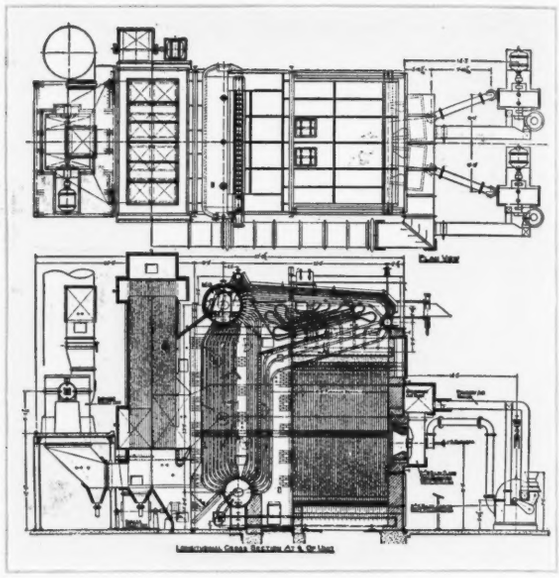
10-cyl, 4-cycle, 1600-hp marine diesel with exhaust-turbine supercharger. European supercharging practice is far ahead of American development, particularly in the use of gas-turbine-driven units

Power hall at Leipzig with diesel and gas engines much in evidence—from small generating sets to the 50-in. cylinder of Fig. 1. Note that the diesel in foreground is in operation

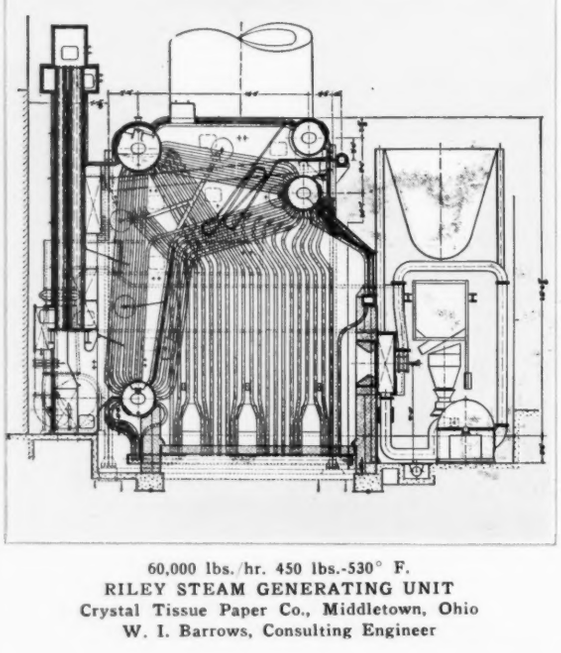
a page of outstanding



Two 375,000 lbs./hr. 645 lbs.-720° F.
RILEY STEAM GENERATING UNITS
W. Va. Pulp & Paper Co., Luke, Md.
This company also has installed Riley units at its Covington, Va., Charleston, S. C., and Williamsburg, Pa. plants.



90,000 lbs./hr. 675 lbs.-710° F.
RILEY STEAM GENERATING UNIT
Port Huron Sulphite & Paper Co., Port Huron, Mich.



60,000 lbs./hr. 450 lbs.-530° F.
RILEY STEAM GENERATING UNIT
Crystal Tissue Paper Co., Middletown, Ohio
W. I. Barrows, Consulting Engineer

Riley in the pulp and

RILEY

Boilers

West Virginia Pulp & Paper Co.
Covington Va.
West Virginia Pulp & Paper Co.
Luke, Md.
West Virginia Pulp & Paper Co.
Charleston, S. C.
West Virginia Pulp & Paper Co.
Williamsburg, Pa.
Port Huron Sulphite & Paper Co.
Port Huron, Mich.
Northern Paper Mills, Green Bay, Wisc.
Hartford City Paper Co.
Hartford City, Ind.
Escanaba Paper Co., Escanaba, Mich.
Imperial Paper & Color Co.
Glens Falls, N. Y.
Whippany Paperboard Co.
Whippany, N. J.
Crystal Tissue Paper Co.
Middletown, Ohio
Container Corp. of America
Philadelphia, Pa.
Kalamazoo Vegetable Parchment Co.
Parchment, Mich.
Finch Pruyn Co., Glens Falls, N. Y.
St. Croix Paper Co., Woodland, Me.

Above installations also use Riley Fuel Burning Equipment.

RILEY

Pulverizers

Champion Coated Paper Co.
Hamilton, Ohio
Gulf States Paper Co., Holt, Ala.
Fitchburg Paper Co., Fitchburg, Mass.
Nekoosa Edwards Paper Co.
Port Edwards, Wisc.
P. H. Glatfelter Co., Spring Grove, Pa.
W. Virginia Pulp & Paper Co.
Tyrone, Pa.
Central Paper Co., Muskegon, Mich.
Oswego Falls Corporation, Fulton, N.Y.
Bird & Sons, E. Walpole, Mass.
Burrows Paper Co., Little Falls, N. Y.
Lang Company, Gloucester, N. J.
Downington Paper Co., Downington, Pa.
Hollingsworth & Vose Co.
E. Walpole, Mass.
Penn Fibreboard Co., York, Pa.
Berst Forster Dixfield Co.,
Plattsburgh, N. Y.

Riley Pulverizers also used with boiler installations at left except Finch Pruyn Company and Imperial Paper and Color Company, where Riley-Harrington Stokers are used.

TRADE MARK Rx REGISTERED

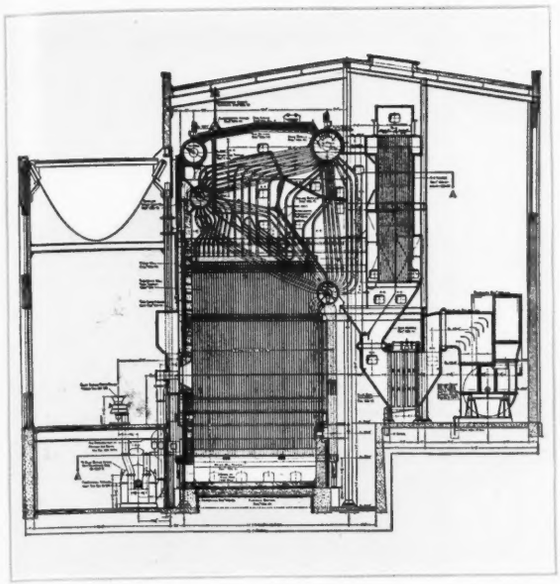
RILEY

STOKER CORPORATION, WORCESTER, MASS.

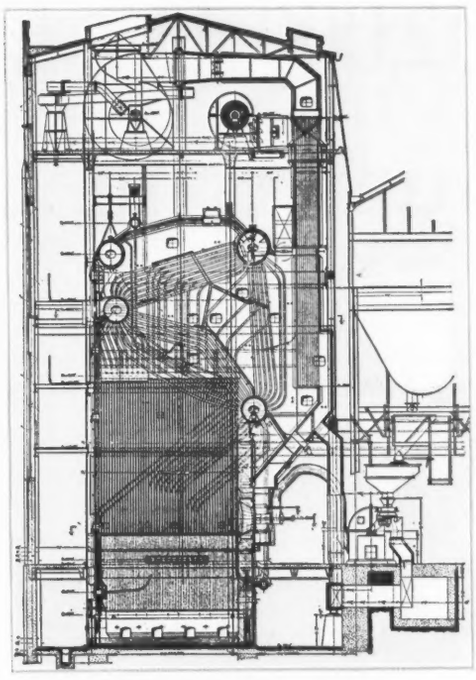
Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver
St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

It will pay you to visit modern Riley Installations

paper mill boiler plants



150,000 lbs./hr. 275 lbs.-650° F.
RILEY STEAM GENERATING UNIT
Kalamazoo Vegetable Parchment Co., Parchment, Mich.
Prof. C. F. Hirchfeld, Consulting Engineer



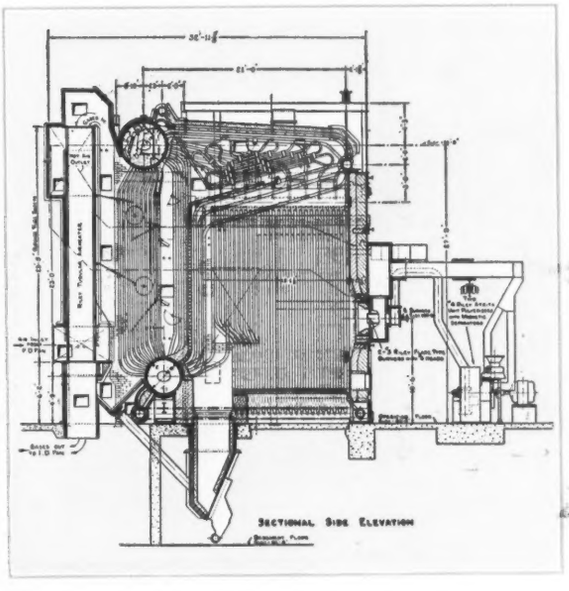
200,000 lbs./hr. 540 lbs.-630° F.
RILEY STEAM GENERATING UNIT
Container Corp. of America, Philadelphia, Pa.
H. M. Wilson Co., Consulting Engineers

paper industry . . .

RILEY RILEY

Traveling Grate Stokers & Underfeed Stokers

Terre Haute Paper Co., Terre Haute, Ind.
Clifton Paper Co., Passaic, N. J.
Clifton Paper Co., Clifton, N. J.
Continental Paper Co. Ridgefield Park, N. J.
Finch Pruyn Co., Glens Falls, N. Y.
Imperial Paper & Color Corp. Glens Falls, N. Y.
Heller Brothers Co. Newcomerstown, Ohio
Flintkote Co., Little Ferry, N. J.
Kimberly Clark Co., Neenah, Wisc.
Robert Gair Co., Montville, Conn.
Haverhill Boxboard Co., Haverhill, Mass.
Stevens & Thompson Paper Co. Walloomsac, N. Y.
Gardner Harvey Paper Co. Middletown, Ohio
Logan Long Co., Franklin, Ohio
Ohio Boxboard Co., Rittman, Ohio
Schmidt & Ault Paper Co., York, Pa.
Kimberly Clark Co., Niagara, Wisc.
Hummel Ross Fibre Corp., Hopewell, Va.
Kimberly Clark Co., Niagara Falls, N. Y.
Minn.-Ont. Paper Co. International Falls, Minn.
Frost White Paper Mills Salisbury Mills, N. Y.
Stevens & Thompson Paper Co. N. Hoosick, N. Y.
Superfine Paper Mills, Utica, N. Y.
Massillon Paper Co., Massillon, Ohio
U. S. Envelope Co., Lititz, Pa.
Hagar Strawboard Co., Cedarville, Ohio
Monadnock Paper Mills, Bennington, N.H.
Waxide Paper Co., Kansas City, Mo.
West Carrollton Parchment Co. W. Carrollton, Ohio
Hoskins Paper Co., Menominee, Mich.



2-750,000 lbs./hr. 700 lbs.-700°F.
RILEY STEAM GENERATING UNITS
Northern Paper Mills, Green Bay, Wisc.
Sargent & Lundy, Consulting Engineers

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

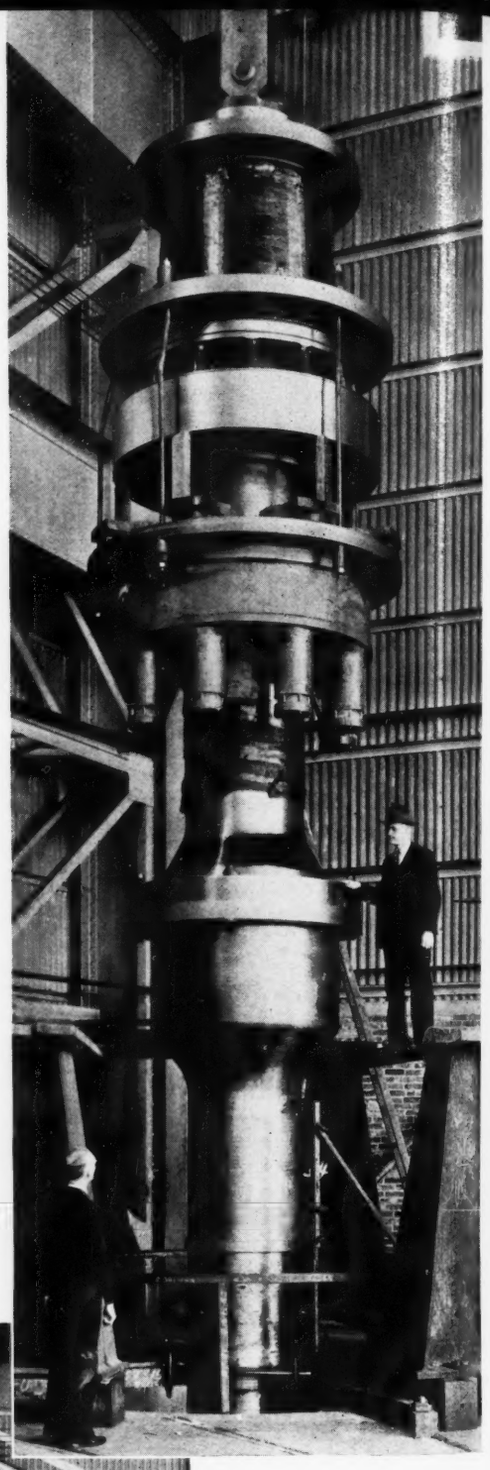
COMPLETE STEAM GENERATING UNITS

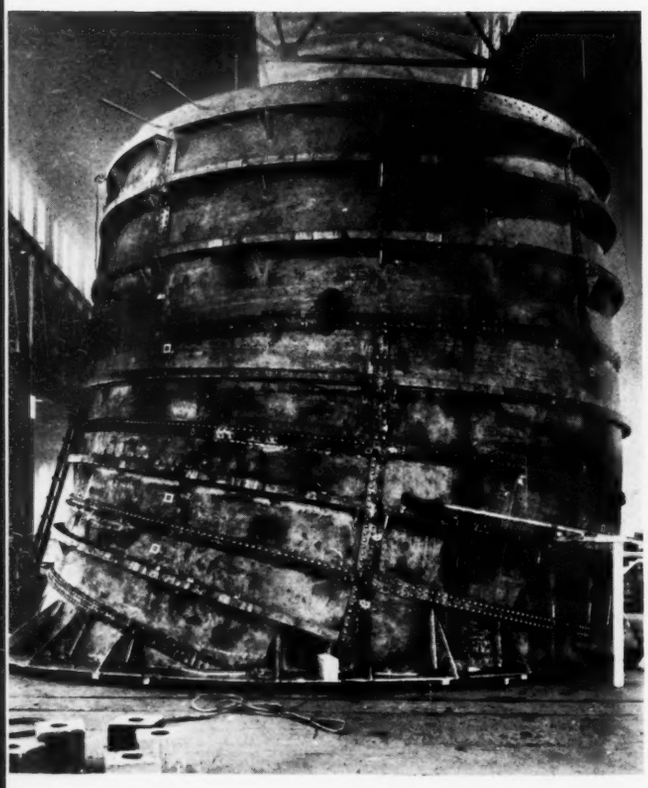
BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment

102,000 Hp for Guntersville

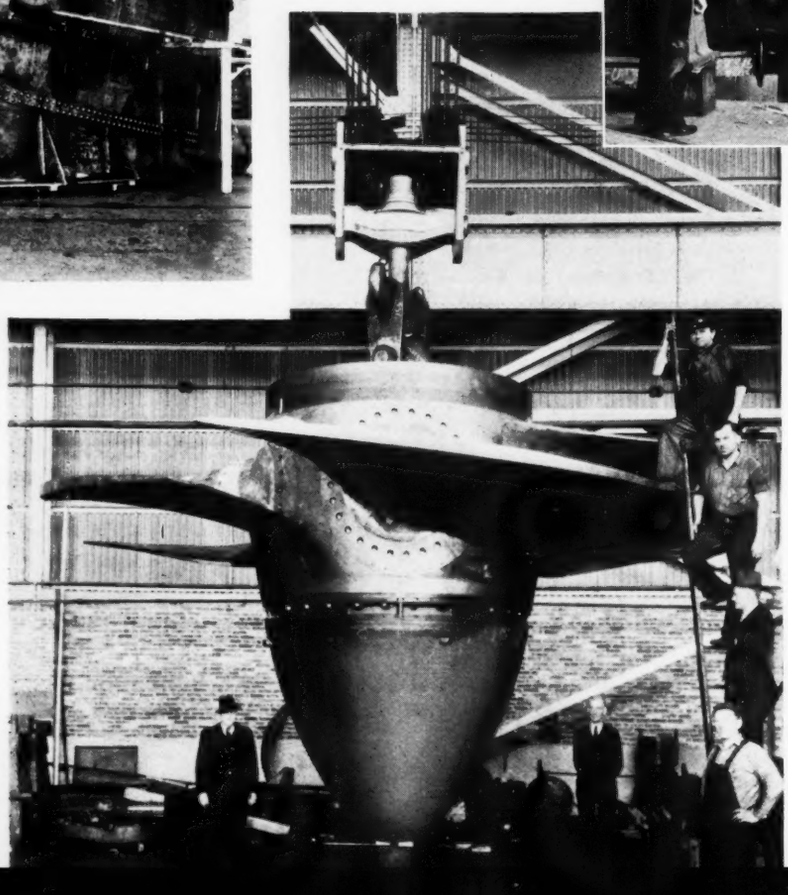
This TVA plant on the Tennessee River near Guntersville, Ala., is designed for four 34,000-hp units, at 36-ft head. Three turbines are now being installed for operation late this year





Right — Shaft and runner-vane servomotor assembly for one of the 34,000-hp Kaplan propeller turbines, in the shops of S Morgan Smith Co. Combined generator- and turbine-shaft assembly weighs 220,000 lb

Left—Plate-steel draft-tube liner is 22 ft 6 in. in diameter at top and 27 ft at bottom, 22 ft high and weighs 93,000 lb



Right—One of the Guntersville adjustable-blade Kaplan-type runners. It is 22 ft 1 in. in diameter, weighs 300,000 lb and will develop 34,000 hp running at 69.2 rpm, under 36-ft head

Do Metals Hurt Turbine Oils?

Fig. 1—Accelerated oxidation tests, with water present and oxygen added continuously, show that tank metal affects oil life

Some turbines seem to be hard on oil, others invariably get many rpm for a lubrication dollar. Research indicates that part of the answer is affect of turbine metals on oil-service life

By B F HUNTER, H A AMBROSE and K P POWERS
Gulf Research & Development Co

BEARING PRESSURES in steam turbines are kept well within the limits of operating safety by designers. However, rubbing speeds are high, often in excess of a mile a minute. Momentary rupture of the oil film can result in bearing failure and, due to extremely close clearances and high speeds, can cause serious damage before the unit can be shut down by the operator. To insure maximum operating safety, turbine designers incorporate the most modern practices in the science of lubrication, including (1) positive-pressure circulating-oil systems, (2) copious quantities of oil to bearings, (3) oil coolers, (4) oil filters, (5) adequate quantity of oil in the system and a reserve storage tank.

The most common difficulties encountered in lubricating of steam turbines are (1) contamination of oil by water, (2) formation of sludge or gummy deposits, (3) formation of deposits on cooler tubes or piping, (4) oxidation of the lubricating oil.

In the interest of operating safety, operators generally maintain accurate records of lubricating-oil service and operating conditions, including (1) bearing temperatures, (2) oil temperatures, (3) ambient temperatures, (4) number of hours the oil has been in service, (5) periodical chemical and physical analysis of the oil.

The useful life of a given turbine oil within recognized operating safety limits varies from one unit to another and it has long been recognized by operators and engineers that some turbines are chronic offenders with reference to oil life.

As a result of this condition, Gulf Research & Development Co undertook a study of unknown or unrecognized factors influencing turbine-oil life. Specific units were selected, which from design and operating conditions seemed identical but in which oil life varied widely.

It is well known that metals and metallo-organic compounds (such as naphthenates) usually accelerate oil oxidation. Metals which increase the rate of sludge formation in some petroleum oils include[a] copper, brass, tin and zinc. Iron, nickel and aluminum are said to be relatively inert in this respect.

Experiments on the rate of increase of acidity in transformer oils show that the following metals are increasingly effective in promoting acid formation, in this order: lead, tin, copper[b]. They also increase the rate of sludge formation in the same order.

Another rating of metals as oxidation accelerators was shown by Dornte[c],

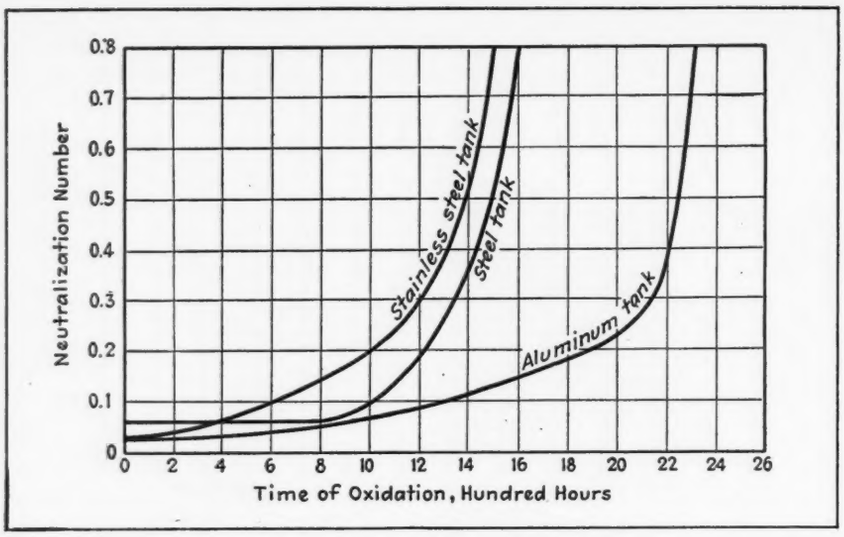


Fig. 2—Acids form less rapidly in the aluminum tank

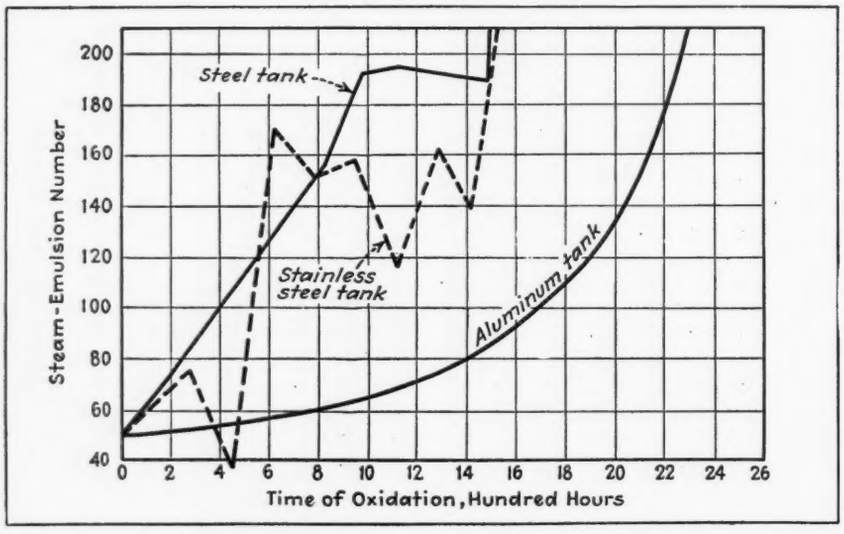


Fig. 3—Tank material also has a marked effect on emulsification quality

who measured the rate of oxygen absorption by a lubricating oil of moderate viscosity (315 SSU at 100 F) at various temperatures. The following metals were increasingly effective in promoting oxidation in the order given: tin, iron, lead, copper.

In contact with oils undergoing oxidation, metals react with organic acids to form soaps or metallo-organic compounds. These compounds act as oxidation accelerators promoting formation of acidity and sludge and increasing oil viscosity. It is usual for traces of organic compounds of iron to be found in sludges taken from steam-turbine lubricating systems and for compounds of copper to be found in samples of sludge removed from Admiralty metal oil-cooler tubes.

At elevated temperatures, some metals and alloys are quite rapidly attacked by oxidized petroleum oils when the acidity becomes excessive, for example, when the neutralization number exceeds 0.5. The determining factor in the rate of corrosion is not the absolute amount of acidity present, but the types of acid formed in the oil. The resistance of a metal to corrosion may be altered by alloying it with other metals. A typical example of this is stainless steel, some varieties of which contain chromium, nickel and molybdenum, often in relatively large amounts. Pure lead is quite susceptible to corrosion by oxidized petroleum oils, but when alloyed with relatively small amounts of antimony or tin or a combination of these, the lead is protected against corrosion[d]. The ordinary babbitt bearings for automotive crankshafts and connecting rods never show appreciable corrosion.

In a relatively large number of cases it has been found possible to avoid corrosion or reaction with oxidized petroleum oil either by alloying the metal under consideration, or by substituting a metal particularly resistant to corrosive attack. Although there is a slight reaction between oxidized petroleum oil and common metals of construction, such as steel, the attack is superficial at ordinary operating temperatures and is so slight as to be of no consequence so far as the steel is concerned. However, the action is detrimental to the oil.

Oils, and this includes turbine oils, are now on the market which are particularly resistant to this superficial chemical reaction with metal. The reaction involves the formation of small amounts of metallo-organic compounds which promote oxidation, but it is not of sufficient extent to be of any damage to the metal surfaces.

Where it is practicable to do so, it is desirable to eliminate copper from the lubricating-oil system of steam turbines. The elimination should also include copper alloys, excepting those that have been found to be as unreactive with oxidized oil as ordinary steel.

Laboratory Tests

Accelerated laboratory oxidation tests have confirmed the fact that copper promotes deterioration of oil to a greater extent than does iron. The major portion of the material for construction of steam-turbine oil-lubrication systems is steel. Occasionally bronze is used for pipe fittings, but piping and storage tanks are usually of steel. An interesting comparison was recently completed in the Gulf laboratory on the effects of stainless steel and aluminum on the oxidation rate of two representative steam-turbine oils.

Each oil sample, with 10% water added, was contained in a cylindrical metallic tank of 2 gal. capacity. The tanks were constructed of the metal under test. Pumps and short lengths of connecting pipe were of steel or iron. The oil and water mixture was maintained at a temperature of 195 to 200

BIBLIOGRAPHY

(a) Kalichevsky and Stagner, "Chemical Refining of Petroleum." The Chemical Catalog Co, N. Y. (1933)

(b) Haringhuiren and Was, "Research of Thin Layers of Tin and Other Metals." Technical publications of the Tin Research & Development Council, Series A, No. 29 (1933).

(c) Dornte, "Oil Oxidation." Ind Eng Chem 28, 11, 1342 (1936).

(d) Underwood, "Automotive Bearings, Effect of Design and Composition on Lubrication." Symposium on Motor Lubricants, ASTM, Chicago, March, 1937.

F and circulated at the rate of several gallons per minute, being picked up at the base of the tank and returned at a point just below the oil level. Oxygen was supplied to the inlet of the gear pump used for circulation at a rate of 5 liters per hour; the gas was vented from each tank at an opening in the cover. Oil samples were taken periodically for measurement of neutralization number and steam-emulsion number.

A number of representative turbine oils were tested over a period of months, all of which showed similar influence of the effects of various metals. However, the indicated useful life of the several oils varied widely.

Fig. 2 illustrates the rate of increase of neutralization number with time for the oil having the longest indicated useful life. A neutralization value of 0.80 was arbitrarily selected as a point to terminate the test. The neutralization value of 0.80 should not be regarded as having any other significance than an arbitrary point to terminate the test, since turbine oils in actual service frequently show a neutralization value of 5.

The indicated useful life of the oil in the presence of aluminum is 46% greater than in the presence of steel.

Conclusions

Steam-emulsion values of the various oils under test were taken simultaneously with neutralization. Fig. 3 shows the steam-emulsion values for the same oil as Fig. 2.

The results of this study indicate that a longer useful life of turbine oils may result by use of metals in oiling systems less catalytic oxidation of lubricants.

Of the various metals tested in this laboratory to date, aluminum has shown the least catalytic effects on the oils tested. The investigation is being continued with various metals and various oils with a view toward further improving turbine-oil life.

Generally speaking, the life of turbine oils may be extended by observing the following simple rules:

(1) Minimize contamination by foreign matter, such as water and solids.

(2) Maintain the oil in the lubricating system at as low a temperature as practicable.

(3) Eliminate unnecessary aeration of the oil.

(4) In construction of the lubrication system use metals having a minimum accelerating effect upon oil oxidation.

✦ ✦ ✦

Snake in the Glass

By Murray Kaplan

IT ALL GREW out of some trouble on my job that I was relating to Frank some two years ago. Frank was a snake collector and I was an engineer in a small oil refinery.

I was telling him about difficulties we were having with clogging and scaling in our heat-exchanger equipment and stills. Things were getting so bad that plant shutdown was imminent. Many of the heat exchangers were old timers in which heating was accomplished by passing oil through double helical turns of piping.

Frank became more and more distracted until I became conscious that he was being bored by my tale of woe. However, he assured me that he was very much interested in my problem—in fact, I had really misinterpreted his apparent distraction which really was the formulation of a solution to my problem. He suddenly startled me, "Why not use snakes?" While my reactions included visions of Frank in a straightjacket, I listened open-mouthed.

"Here's the way," said Frank. "We will select those snakes which are known for their augering propensities and affix sharp claws to their backs and send them scurrying through the tubes." Spurred by his unquestionable sincerity, we waded into snake literature and found a species, *Vivace augeratus*, which was adapted by nature to bore through hard formations.

Several of these were secured and immediate results, though on a small scale, pointed towards success. Further

research and breeding these with a species known for speed, *Hasticus acceleraticum*, produced a breed specially suited to our purpose. Individuals in this new breed were subsequently found to be particularly adapted for different jobs; some were better for descaling, others for breaking up caked oil, etc.

Soon orders for use of our snake service blizzarded our desks. This forced us into research to increase the efficiency of our service. One major improvement was a substitute for the scrapers we tied to the snakes. Instead, by experimentation we found that we could metal spray in small peaked paths along the snakes ribs and spine. This method at first was doomed to failure because the more industrious snakes scraped right through the tubes.

We give credit to Mr James Veedle who suggested a remedy for this difficulty by the simple expedient of using a charged follower wire tied to each snake. The snake would then bore and scrape until it came to bare metal; then, shocks would discourage any further action at this spot. This allowed meticulous cleaning service because the snakes would linger at one particular spot until they had cleaned through to bare metal, whereupon the electric shocks would urge them further on to another dirty spot.

For particularly tough jobs we have two reptiles which we have named Coil-biscuit and Tar Admiral. They are kept in luxurious quarters which include sunken pools. At the moment, we are engaged with the Social Securing Bureau for an equitable old-age pension for our reptiles.

The great success of our method, which is helped by a lack of labor trouble, has so flooded us with orders that we must necessarily keep our address secret until we can urge the propagation of this particular species to such numbers that we can cope with all orders. While we naturally take careful inventory of our limited reptilonnel, on one occasion in the cleaning of a ramified plant using our entire force, we missed one of them, which we sincerely hope will not turn up wriggling in a gage glass.

While we must now be secretive about our address, we advise those who may be interested in this obviously lucrative calling that they make a preliminary study of snake lore. Very soon we will be in a position to license agencies in all parts of the world except Ireland.

Small Plants Get Attention

Midwest Power Conference puts some of the country's best power minds to work on the problems of small utility, industrial and institutional steam plants

Fig. 1—Conference "prime movers" (left to right): Prof S E Winston (Armour), Secretary of Conference; Ralph E Turner (Editor of Power Plant Engineering), Chairman of Chicago Section ASME; Dean L E Grinter (Armour, Graduate Div), Conference Director; J A Fitts, Chairman of Chicago Section AIEE

CHICAGO, ILL., APRIL 7—Small power plants, so often neglected by engineering conventions, received ample attention at the Midwest Power Conference, held April 5–7, Palmer House, Chicago. One session was devoted exclusively to small utility, industrial and institutional steam plants and another to diesel engines. Additional papers dealt with research, central-station development and design problems, metallurgy for high pressures and temperatures, rural electrification, air pollution.

This, the second Midwest Power Conference held under the auspices of Armour Institute of Technology, was sponsored also by the University of Wisconsin, Iowa State College, State University of Iowa, Michigan State College, Purdue University, State University of Illinois, University of Michigan.

In the first formal address of the Conference, L W Wallace, Director of Division of Engineering and Research, Crane Co, outlined some of the achievements of research in power. The electrical industry, he said, has been a major factor in stimulating research extending far beyond strictly electrical problems. He listed automatic power-plant control and the perfection of long-lived and dependable equipment as specific problems now uppermost in the minds of power men.

In the absence of Alex Bailey, Chief Operating Engineer of Commonwealth Edison Co, his paper on "Central Station Developments" was read by A E Grunert, Supt of Generating Stations for the same company. At present, wrote Mr Bailey, "creep" limits top steam temperature to about 900 F for general use. Welding has become practically universal. Forced circulation boilers for high pressures are seriously considered. He referred favorably to the "recommended turbine standards" of the National Defence Power Committee as an intelligent means of reducing first cost and speeding deliveries, without necessarily retarding equipment development.

Small Plants

Speaking on the problems of the small industrial power plant, F Elwell, Works Engineer, Buick Motor Division, General Motors, Flint, Mich., made the following points, among others: Locate plant close to center of load if this does not interfere with water and coal supply, etc. Be sure plant equipment (particularly boilers) is flexible enough to handle load swings. To avoid heavy cost of air lines it may pay to place compressors near points of major use. Big savings can be made by men assigned to constant checking of distribution and application wastes. Watch condensate returns for possible contamination from chemical processes and other sources. It is sometimes possible to salvage much heat by discharging high-pressure traps to a flash tank and leading flashed steam to low-pressure main.

Mr Elwell urged ample metering and adequate cost records, a regular follow up on guarantees, plant design for easy operation and maintenance, careful selection of plant personnel.

Basic principles applicable to small utility, municipal and university power plants were neatly combined in a single paper by G A Gaffert, Mechanical Engineer of Sargent and Lundy, Chicago. He confined himself to plants under 10,000 kw, mainly those under 5000.

Rising in relative importance, he said, fixed charges are now more than half of the generating cost in small central stations and municipals. Hence equipment standardization is more attractive than Btu chasing in design. The standard is 450 lb and 750 F steam; only special considerations should warrant departures.

The relative gains from rising pressures are much less in small condensing plants than in large, he said. With $3.00 coal and 50% load factor, it would take about 10 years for 650 lb and 825 F to pay its increased first cost. Cost and efficiency considerations strongly favor few boilers and few turbines.

Means suggested for reducing first cost included elimination of curtain walls between boilers and turbines, centralization of control and the use of precast concrete roof slabs.

Combined demand for electricity and heat make the problems of the university power plant entirely different, said Mr Gaffert. The balance between heat and power loads is none too good because of seasonal and hourly variations. Thus it often pays to buy power in summer, and sometimes throughout the year. Often the best arrangement is a backpressure turbine for winter use and a bleeder-

condensing unit for summer. Mr Gaffert spoke well of forced-circulation hot-water heating for establishments of moderate ground area, free from excessive variations in level.

G G Post, Wisconsin Electric Power Co, listed the three fundamentals of generating-station design as: (1) reliability of service, (2) convenience of operation, (3) dollar efficiency. Close coordination of operating and design staff under a single head is essential, particularly for 1 and 2, said Mr Post. Controls should be grouped. Machines should be easily accessible for maintenance and repair. Maintenance should be scheduled in detail to avoid forced outages. Machine shop should be easily reached and well equipped. Safety should be "designed into" the plant.

In closing, Mr Post again stressed the necessity of working operating experience into the plant design at all stages. Approval of a completed design by the operators is not enough.

Recent contributions of metallurgical research to safe and economical operation at high pressures and temperatures were summarized by J C Hodge, Chief Metallurgist, Babcock and Wilcox, and by J J Kanter, Research Metallurgist, Crane Co.

Hydro Power

As Chairman of the Chicago Section of the ASME, Ralph E Turner, Editor of *Power Plant Engineering* presided at the joint luncheon with the ASME on the first day of the Conference. Marc G Bluth, National Coal Assn, vigorously attacked TVA and similar governmental hydro power projects. His main points were: (1) they are uneconomic, (2) their published power "costs" are not honestly computed, (3) they take from the taxpayer and give to the consumer, (4) they mortgage the future, (5) they reduce the annual coal demand by millions of tons and thus take employment from coal miners, (6) actually, steam power is almost always cheaper than hydro.

These papers were followed by two on rural electrification in Wisconsin, presented by B E Miller of Wisconsin Power and Light, and by V M Murray, chief engineer of Wisconsin Development Authority.

Air pollution by boiler stacks was discussed from the research angle by R V Kleinschmidt of A D Little Co. Loyd R Stowe, director of Chicago's Air Pollution Survey, reported tremendous progress toward clean air in the Midwest metropolis.

For fine dust removal by spray washers, said Dr Kleinschmidt, the most important thing is extremely fine spray. Larger water particles are ineffective. Higher nozzle pressure helps by increasing both velocity and fineness. Acid gases are easier to absorb than fine dust. Thus dust and SO_2 can be removed simultaneously by a fine spray of alkaline water.

Fig. 2—Power men (left to right); Prof H O Croft (State U of Iowa); A E Grunert, Supt Generating Stations, Commonwealth Edison; L W Wallace, Director Division of Engineering and Research, Crane Co; W L Abbott, Chicago steam pioneer

Discussing this paper, K W Miller of the Utility Research Commission said that local conditions and the very high sulphur content of Illinois coal would make application of complete stack gas "laundering," as at Battersea, London, entirely impracticable in Chicago.

Mr Stowe reported 30 years of progress in cleaning Chicago's air, progress greatly accelerated in recent years. At all times the utility plants have played a minor part in air pollution; industrial, railroad and domestic stacks have each been more "smoky." Outstanding progress has been made by the railroads, who have, for example, installed smoke catching and washing equipment in more than 30 Chicago round houses.

Power-Plant Auxiliaries

"Power-Plant Auxiliaries," by Geo C Daniels, indicated that too many protective devices may defeat their own purpose by adding complications. Simplicity is a vital ingredient of reliability.

Quick starting, said Mr Daniels, is essential for some auxiliaries. Auxiliary maintenance should be scheduled. He reported general preference for squirrel-cage motors for most auxiliary drives. In the case of draft fans, speed changes may be obtained by hydraulic coupling or by using two motors of different speeds.

Fitting a time of constant international tension, the program of the Conference dinner, held jointly with ASME, AIEE and Western Society of Engineers, featured the hookup of defense preparations and power facilities. C L Rice, vice president of Western Electric, presided as toastmaster. Speakers were M W Smith, engineering manager of Westinghouse (Pittsburgh) and Dr William McClellan, president of Potomac Electric Power Co and president of the American Engineering Council.

Speaking on "Power Transmission in a National Emergency," Mr. Smith considered what could be done by taking a few liberties with the economic and dependability standards of peace times. Today, he said, average transmission distance in the U. S. is under 20 miles, most power coming from highly economical steam plants near load centers.

Considering possible failure of railroad coal delivery to these plants, he noted that the real bottle necks are the terminals, through which most central station coal does not pass. There is little possibility, he said, that main rail lines will be overloaded with coal traffic.

In Dr McClellan's opinion, preparedness is essential to protect American rights and interests, not so much within the United States as on the ocean and abroad. Preparedness, he said, is the best guarantee of peace.

Friday-morning sessions, held at Armour Institute of Technology, featured papers by Arthur L Rice, editorial director of *Power Plant Engineering*, and by R V Terry, hydraulic engineer, Newport News Shipbuilding and Dry Dock Co.

Mr. Rice stressed the importance of power statistics — correct statistics, honestly used. He urged that data presented to top management by power

(*Continued on page 150*)

Readers' Problems

Questions for Our Readers

Sparking Oil Ring

Question 1

WE HAVE *noticed sparks similar to static sparks whenever the oil ring in the outboard bearing of our turbine-generator comes in contact with bearing metal. An examination of this bearing shows its surface coated with a hard chocolate-brown deposit having numerous small pits that extend into the metal itself. What causes this trouble and how can it be remedied?* —SHC

Leaking Tubes

Question 2

RECENTLY *we retubed two Manning firetube vertical boilers. After the job was finished, we found so much oil on the tubes that it was necessary to clean them with soda ash to prevent foaming and priming. However, the boilers did prime before the oil was entirely removed. Since that time, the joints where tubes meet crown sheet have started to leak. Can this be attributed to foaming or is some other cause more likely?*—MCC

SUITABLE answers from readers will be paid for if space is available for publication.

Carryover

Answers to March Question 1

The Question

WE HAVE *a 72-in. x 18-ft hrt boiler supplying our engine and laundry machinery. When carrying 100-lb pressure, with two gages of water in the boiler, we are troubled with water going over to the engine. No trouble occurs with higher water in the boiler, when pressure is 75-80 lb. The steam header from which supply of live steam is drawn is provided with a trap for drainage, and there is a separator with a discharge trap in the line to the engine. What causes the trouble?*—STA

Two Frequent Causes

TWO OF THE most frequent causes of STA's trouble are: steam piping that is too small, and high concentrations of alkali salts. In the first case, if steam piping is too small to handle peak loads, the necessarily high velocity materially assists in picking up water and sweeping it over to the engine. The remedy is apparent —the larger pipes or receivers are, the slower the flow of steam and the greater the tendency to deposit entrained water in traps or receivers.

Chlorides in boiler water divided by chlorides in feedwater equals concentration. At normal loads, concentration may be balanced with scale-forming salts to maintain a certain degree of surface tension of boiler water and steam bubbles. Any increase in steam velocity due to excessive peak loads causes a lowering of surface tension and results in carryover. The remedy is a feedwater control outfit and a close watch on chlorides and concentrations.

Galt, Ontario, Canada H PARKINSON

Pressure Too High for Traps

CARRYOVER may be caused by failure of traps on header and separator to discharge condensation at the higher pressure, although perfectly OK for lower pressures. Traps are normally designed to work in certain range of pressures (manufacturers rate traps in terms of capacity at a stated pressure); if pressure is above or below stated range, new valves and seats must be installed. This need arises from the fact that, whether traps are of the float or bucket type, the area of the valve may be such that the higher pressure holds it closed regardless of the fact that the float is submerged or the bucket full. The trap mechanism is not powerful enough to open the valve against higher pressure, therefore condensation collects and eventually is picked up by the steam and carried over to the engine cylinder.

In my opinion, if STA fits his traps for higher pressure he will have no more trouble. I do not believe that water carries over from the boiler because at the higher pressure, his engine would take less steam to do the same work. Therefore, it would have less tendency to lift the water than would be the case at lower pressure when the engine would be operating at a later cutoff.

Dorchester, Mass. W F O'REGAN

Stoker Too Close to Shell

IT HAS LONG been common practice among operating engineers to throttle steam supply when troubled with carryover. This reduces to a safe value the moisture content of steam trapped in the cylinder when the exhaust valve closes. The same effect can be produced by reducing pressure at boiler. Four factors contribute to this effect: (1) when steam expands from 100 lb to any selected backpressure, there will be more moisture in the exhaust than when expanding from a lower pressure to the same backpressure, (2) greater radiation loss at 100 lb, due to higher temperature difference between engine parts and surrounding air, increases moisture content, (3) greater temperature range in the cylinder when using higher pressure produces more initial condensation, and (4) greater volume at 75 lb than at 100 means more friction loss due to higher velocity; this friction is converted into heat and superheats steam if dry, or evaporates part of moisture content, thus producing drier steam at lower pressure.

A probable cause of carryover would be insufficient space between stoker and shell; there should be 10 ft between floor and bottom of boiler shell for a single-retort underfeed stoker, although a minimum distance of 7 ft may be acceptable.

Another probable cause may be excessive alkalinity. Since zeolite softeners are almost universally used in laundries and softened water is blended with raw water for boiler feed, it is essential that boiler water be checked (titrated) at least daily to insure proper proportioning. Testing sets for this purpose are inexpensive and procedure for making tests can be learned in a short time by following simple instuctions that are readily available.

Rochester, N. Y. JULIUS BRODSKY

Blames High Output

STA GIVES the size of boiler but does not give size of engine and laundry machines or, what is more important, the total output of the boiler. When it is necessary to carry 100-lb pressure on the boiler, I assume that steam output is greater than when 75-80 lb is carried. Under these conditions, with an excessively hot fire being carried and the boiler being forced considerably above capacity, priming could take place regardless of water level.

Waterbury, Conn. F W CARTER

Had Similar Experience

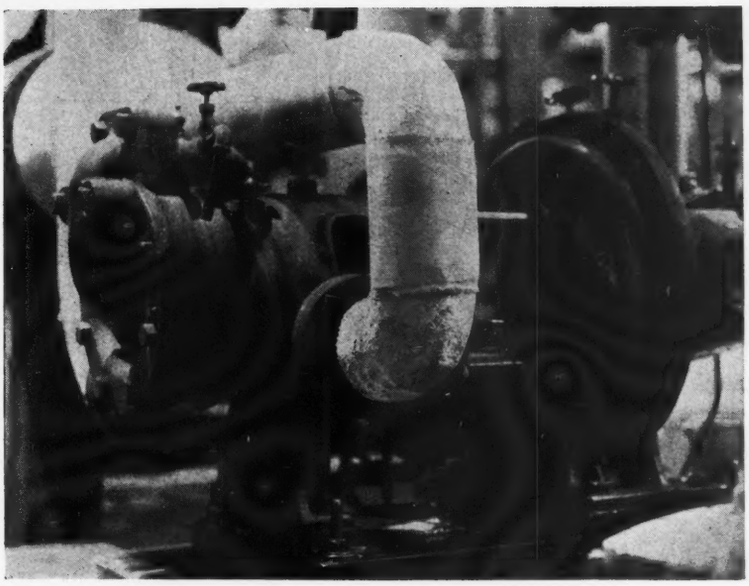
OUR NO. 2 BOILER acts somewhat like STA's; there is little steam space and when water is two gages in the glass it will go over the top if the boiler is forced. This boiler used to pull over pretty badly before we increased size of steam header and carried water lower in the glass; we now manage to get by with this unit.

The reason that STA's boiler carries over at 100 lb and not at 80 lb is that the greater velocity at higher pressure causes bubbles to rise higher. There might be a possibility that STA is using a water treatment that makes the water too soft; this will make it carry over also. It would be advisable to check this to make sure.

Sloat, Calif. R L BROWN

More About Traps

IT OCCURS to me that STA's trouble does not lie in the boiler but may be due to improper drainage of steam header and separator. Traps which depend on weight



Close-Coupled Boiler-Feed Pump

R H SOGARD's article on page 102, January POWER, calls attention to the 2-stage, motor-driven, close-coupled pump used for boiler feeding at the University of Missouri. This type of pump is also available with steam-turbine drive. The photograph shows an installation which has been operating on boiler-feed service for nearly two years. This is a close-coupled pump in which the turbine rotor and pump impellers are carried on the same shaft by two large ball bearings mounted in the end brackets of the turbine. The governor and overspeed trip are placed on the outboard end of the turbine. The pump shown was designed to deliver 100 gpm against 590-ft total head when handling 220-F feedwater.

At the present time, the turbine operates on 150-lb steam with 100-F superheat and 5-lb back pressure. The turbine is designed so that at a future date when changes are made in the plant, it will also be satisfactory for operation on 250-lb steam with 15-lb backpressure and 150-F superheat, a total temperature of 556 F.

New York, N. Y. R BEHRENS
Ingersoll Rand Co

---

of a bucket or float to open the trap valve against the unbalanced pressure due to the size of the trap orifice, require a change in size of discharge orifice when pressure is increased beyond the pressure range for which the orifice was designed.

STA can check operation of header and separator traps by opening a union in the discharge line and noting action under both conditions of pressure, or he can inspect seat and disk for marks indicating design pressure. Noting the temperature of the trap itself under both conditions may indicate the trouble, as a trap will become cold if inoperative for a long period. All traps in the writer's plant are equipped with ¼-in. "telltale" valves on the discharge side and are checked hourly for proof of operation.

Plymouth, Mass. C B HUDSON

Blames Water Condition

BOILER-WATER condition is evidently the cause of carryover or priming experienced by STA. The presence of organic matter or too high concentration of mineral solids in the boiler water will cause priming, the amount of which is also a function of steam production. STA evidently produces more steam at 100 lb than at 80, and the additional production is sufficient to cause the carryover which starts at about 80 lb. Also steam density is greater at 100 lb, with a corresponding tendency to carry more water per unit of volume. Increased blowdown aimed at decreasing solids content should eliminate the trouble.

Traps connected to a steam line are ineffectual in removing entrained moisture. The separator should be more efficient and is probably suffering from a drain or trap being blocked with sludge, or the separator may have been too small originally.

Saltville, Va. J C PORTER

Tried Lowering Water Level

IN A LAUNDRY plant where I was employed we had a boiler similar to STA's which carried 125-lb pressure, and was fitted with an automatic high- and low-water alarm. We found by experience that carrying two gages of water was quite high for work where variable loads occur. We changed to about one and a half gages of water, which gave a larger space for steam to expand, created drier steam and did away with slugs of water being carried over to the engine. We found that after lowering the water level, no matter how much load was carried or demanded suddenly the danger of water carrying over to the engine was controlled.

We also changed the steam trap from the steam header and placed it in the valve gear. Since then (18 months ago) we have had no trouble with water in the cylinder. Traps and separator are given periodic inspection to eliminate trouble that may arise from faulty operation due to wear or erosion from impure water.

Philadelphia, Pa. W F MULLEN

Changing Heating System

Answers to March Question 2

The Question

WE HEAT *two buildings from the same boiler, one on steam and the other on hot water. We use a closed heater to raise temperature of water for the latter, and a circulating pump to force water through the system. Would it be possible to change the hot-water system to a direct-steam system, and if so, could it be done inexpensively?*—EAD

Change Is Practical

IT IS PERFECTLY practical to heat both buildings with direct steam, provided the system is arranged so that steam will circulate and condensate will be removed. Inasmuch as EAD does not give any details of the hot-water system other than that it has a circulating pump, it is not possible to answer his question in other than a general way. If he will procure a current issue of the HEATING, VENTILATING, AND AIR-CONDITIONING GUIDE, published by the American Society of Heating and Ventilating Engineers, he will find standard heating systems described and illustrated in a way which should enable him to make the desired change.

Lexington, Ky. I A BUTCHER

Might Be Expensive

IT IS POSSIBLE that EAD's hot-water heating system could be converted to steam, but it is probable that the cost would be high. A complete survey should be made, considering the following points: (1) there would probably be more radiation than required with steam since heat output of hot-water radiation is taken as 150 Btu per hr per sq ft, while steam radiation is rated at 240 Btu. (2) if there are radiator valves at present and they are the type with a hole to insure a small amount of circulation at all times, they would not be satisfactory without alterations.

(3) A trap of suitable size would be required for each radiator and preferably an orifice in each radiator inlet, and (4) it is likely that supply piping would be

(*Continued on page 132*)

Engineers' Bookshelf

Power Factor

POWER-FACTOR ECONOMICS (1939). *By Price L Rogers. Published by John Wiley & Sons, Inc, 440 4th Ave, New York, N. Y. 143 pages, 6 x 9 in., 30 illustrations, 41 tables, cloth binding. Price $2.50.*

Control of power factor is a problem that confronts every engineer that designs or operates ac power systems and equipment. In this book, these problems are dealt with as they apply to both industrial and public-utility systems. A great deal of the material is presented in table form and in worked out problems dealing with power-factor correction.

Aside from the many smaller tables there are two main groups: One of these gives the kilowatt input, efficiency and power factor at full, 75% and 50% load for the various types of induction motors from 0.5 to 200 hp and from 3550 to 575 rpm. Another group of tables gives the capacitor kva required to correct the power factor of the previously mentioned motors to 85%, 90%, 95% and 100% when the motors are operating under full, 75% and 50% load.

Diesels

DIESEL ENGINES (1938). *By B J von Bongart. Published by D Van Nostrand, 250 Fourth Ave, New York, N. Y. 416 pages, 6x9 in., profusely illustrated, cloth binding. Price $5.00.*

Primarily designed as a classroom textbook on internal-combustion engines of the compression-ignition type, this book will also be of use to the practicing engineer. The author begins by tracing the history of the diesel and then by presenting the thermodynamic and combustion theory which explains its operation.

After considering fuel oils, successive chapters treat of the equipment for handling and burning them: fuel pumps, injection nozzles, common-rail systems, air-injection systems. Considerable attention is given to combustion chambers, before taking up special kinds of engines for automotive, aircraft, and stationary service. Chapters on design features and accessories complete the book.

DIESEL ENGINEERING (1939). *By J W Anderson. Published by McGraw-Hill Book Co, Inc, 330 W 42 St, New York, N. Y. 269 pages, 6x9 in., 149 illustrations, numerous tables, cloth binding. Price $3.00.*

Supplementing "Diesel Engines" by the same author, this text follows the lead of "Diesel Operator's Manual" in amplifying a specific phase of diesel-engine practice, in this case, fundamental principles. Beginning with an extended discussion of theoretical and actual cycles, the author develops, in logical sequence, the questions of fuels, combustion, combustion chambers, fuel-injection systems, and governing. These factors are all basic in determining engine performance and so it is natural to follow them by a chapter covering thermodynamic and mechanical losses, power taken by auxiliaries, measuring over-all performance, and correcting performance for changed conditions.

Chapters on important accessory functions such as cooling and lubrication, differ from the usual presentation in viewpoint; emphasis is on the relation of engine design to these important functions. Purely mechanical aspects of design are studied first from the theoretical viewpoint, and the discussion of mechanics and dynamics is followed by notes on the design of various engine parts. Chapters on general design and installation principles complete the book.

Although a working knowledge of mathematics, thermodynamics, and mechanics is presupposed, it is possible for the engineer lacking parts of this background to follow the book satisfactorily.

Refrigeration

REFRIGERATING DATA BOOK (*4th Edition—1939*). *Published by the American Society of Refrigerating Engineers, 37 W 39th St, New York, N. Y. 520 pages, 6x9 in., numerous illustrations, charts, tables, fabrikoid binding. Price $4.00.*

The 4th edition of this standard reference work marks a new departure: the volume published this year covers refrigerating principles and machinery, and editorial work is now under way on a second volume, to be published in 1941, and to cover applications of refrigeration. Present plans call for revision of each volume at 4-year intervals, starting with 1939 and 1941 respectively. By this procedure the editors hope to cover a broader field and still keep abreast of new developments.

Most of the material in Volume I is new, but the familiar style and format is retained. An innovation is use of specifications of trade-named mechanical equipment. In addition to comprehensive data on all phases of refrigeration, this volume contains a catalog of refrigerating equipment, indexed by products, a directory of distributors, and a list of members of the ASRE, arranged alphabetically and geographically.

Patents

PATENT TACTICS AND LAW (Revised Edition of "Patents"—1939). *By Roger Sherman Hoar, commercial attorney of Bucyrus-Erie Co. Published by Ronald Press Co, 15 East 26th St, New York, N. Y. 315 pages, 6x8½ in. Price $4.50.*

Just enough patent law in plain English to enable an industrial executive to get on common ground with his patent attorney and work out "tactics" for any patent problem. Patent law is a highly specialized and technical field, but one in which any inventor or industrial plant can become enmeshed. This book answers many of the questions so frequently asked by executives and inventors.

Steam Practice

THE SUPERHEATER IN MODERN POWER PLANTS (1938). *By D W Rudorff. Published by Pitman Publishing Corp, 2 West 45th St, New York, N. Y. 293 pages, 157 illustrations, steam tables. Price $6.00.*

A comprehensive survey of the field of superheating, steam-temperature control and types of superheaters that suit varied boiler designs. A chapter on the fundamentals of computation aids understanding of theoretical problems in heat transfer.

PRACTICAL HEAT (2nd Edition—1939) *By Terrell Croft; revised by R B Purdy. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 726 pages 5½x8 in., 636 illustrations, tables and problems. Price $5.00.*

Retaining the original author's simple style and presentation, Mr Purdy has added materially to the sections dealing with application of fundamentals to modern power-plant design and operation. This book has been a standard reference for many years valued for its understandable teaching of basic power-plant information. With the inclusion of advances in applied practice, it should be in every operator's library.

STEAM-ENGINE PRINCIPLES AND PRACTICE (2nd Edition—1939). *By Terrell Croft; revised by E J Tangerman, Consulting Editor of* POWER. *Published by McGraw-Hill Book Co, 330 West 42 St, New York, N. Y. 513 pages, 6x9 in., 546 illustrations. Price $3.50.*

One of the best practical books on operation of steam engines has been brought up to date to conform to modern practice. Added illustrations and amplified tables supply the necessary data to make the book as useful today as when originally written. Much of the original design information has been retained to cover older types of engines, many of which are still in operation.

Engineers' Manual

THE ENGINEERS' MANUAL (2nd Edition—1939). *By Ralph G Hudson, Professor of Electrical Engineering, Massachusetts Institute of Technology. Published by John Wiley & Sons, Inc, 440 Fourth Avenue, New York, N. Y. 340 pages, 5x8 in. Price $2.75.*

Complete revision of this standard handbook of tables, constants and formulas includes new chapters on heat and electricity.

(Continued on page 130)

Power Lines

Soft-Coal Experts Map Research Program

Members of the Research Committee of Bituminous Coal Research, Inc, decided at a meeting in Pittsburgh, Pa, March 21, which of the many pressing coal problems were to be attacked by research methods, and mapped a program designed to restore large tonnages to the annual production of the industry. The program was based on a proposed expenditure of $235,000 per year.

The 6-point program of technical investigations and service included development of methods and equipment for automatic heating of residences and buildings with a wide range of coals, ceramic and metallurgical heating and melting with pulverized coals, complete gasification of coal, coal-dust engine, and collection and handling of ash without detrimental slagging, clinkering, or discharge into the atmosphere.

Participating in the program conference under the chairmanship of Howard N Eavenson, were J C Cosgrove, president, BCR; J D Doherty, Koppers Coal Co; John Fielding, Jr, Hanna Coal Co; E R Kaiser, Bituminous Coal Research, Inc; E J Kerr, Lorain Coal and Dock Co; O J Menke, Island Creek Coal Co; J B Morrow, Pittsburgh Coal Co; F K Prosser, Norfolk & Western Ry; C A Reed, National Coal Ass'n; G C Ritchie, Chesapeake & Ohio RR; R A Sherman, Battelle Memorial Institute; R F Stillwell, Red Jacket Coal Co; J E Toby, Appalachian Coals, Inc, and C E Williams, Battelle Memorial Institute.

Boiler Failures Caused by Impurities in Water

One boiler in every 170 now in service is physically unsound and unsafe, one boiler out of every seven possesses dangerous defects, and one in every two has minor defects, says J H Eglof, supervisor of agency field service, Casualty Division, Travelers Insurance Co, speaking before members of the Insurance Institute of Grand Rapids, Mich, March 6.

Each year more than 1000 serious accidents and approximately as many persons are killed or injured in these accidents, he pointed out, to say nothing of the enormous property damage that results. The outstanding reason, perhaps, for boiler failures is that less than 10% of natural waters are fit for boiler use because of impurities, and about 80% of all such failures can be traced to the effects of those impurities.

At the present time there are 24 companies writing boiler insurance, and more than $9,000,000 was paid in boiler insurance premiums to 22 of these companies during 1937, the latest year for which complete figures are available. Over a 5-year period ended December 31, 1937, the average number of pressure vessels of different types insured by companies in the United States was in excess of 321,000 units.

Dr. C. F. Hirshfeld Dies

Dr. C. F. Hirshfeld, internationally known engineer and educator, chief of research of The Detroit Edison Co, died at Grace Hospital, Detroit, April 19, after an illness of several months. Born in San Francisco, Jan 30, 1881, Dr. Hirshfeld was graduated from the University of California in 1902, with the degree Bachelor of Science in electrical engineering. In 1903 he became an instructor at Cornell University and in 1905 received the degree of Master of Mechanical Engineering from that institution.

Dr. Hirshfeld remained a member of the Cornell faculty until 1913, advancing to the positions of Assistant Professor and Professor of Mechanical Engineering. During this period he was author and co-author of several textbooks on steam power and internal-combustion engines which are still classics in the field.

In 1913, he became associated with The Detroit Edison Co as Chief of Research, a position he held until his death. He organized the research dept of this company, which is believed to have been the first such department established and maintained by an electric utility company.

Dr C F Hirshfeld

Many other utilities have since established similar departments using this as a model.

Dr. Hirshfeld has directed researches in a wide variety of fields, including problems dealing with design, construction, operation and maintenance of steam-electric power plants and the operation and interconnection of electrical systems; industrial electric heating and other load-building efforts; disposal of industrial waste; problems of electric cable deterioration, electric welding, development of electric furnaces and new methods of generating electric energy.

Norwich Orders New Generating Equipment

Orders have just been placed by the Norwich, Conn., municipal lighting department with Riley Stoker Corp for a complete boiler unit with a capacity of

FLOODPROOF TURBINE-GENERATOR

Largest 1800-rpm turbine-generator turned out by Westinghouse in 1938 was this 75,000-kva hydrogen-cooled unit for James Reed Station of the Duquesne Light Co, on Brunot's Island in the Ohio River, near Pittsburgh. The machine was made flood-proof to guard against such catastrophe as the St. Patrick's Day flood of 1936

75,000 lb per hr in continuous steam delivery, a peak capacity of 100,000 lb per hr, and an average efficiency between half and full load of 88%. The unit includes waterwalls, air preheater, stub stack, fans, controls and insulated setting with oil-burner equipment.

An order has also been placed with General Electric Co for a 9735-kva steam turbine-generator to operate at 650 lb and 750 F, and at 3600 rpm. A Westinghouse condenser will be installed, and the new unit will bring the capacity of the plant to approximately 20,000 kva. Arthur L. Nelson Engineers, Boston, are consultants. The new equipment is to be in operation in about six months.

American Gas Assn Releases Power Figures

According to statistics released by the American Gas Association through the Industrial Gas Section, one-ninth of all electricity generated in the United States is developed by burning gas, or 11% of the national electric load is, if traced back to ultimate sources of energy, actually a gas load.

Some 172,500,000,000 cu ft of natural gas were sold for electric generation in steam power plants during 1938, at an average of 1100 Btu of heating value per cu ft. Assuming the average steam plant efficiency is 22.8%, this gas generated about 12,650,000,000 kwhr of electric energy. According to the Edison Electric Institute's latest estimates, 113,850,000,000 kwhr of electric energy were produced in 1938 by the electric light and power industry, 67,600,000,000 kwhr of the total being generated in fuel-burning plants. Thus, one of every 9 kwhr produced by all central stations, or one of every 5 kwhr produced in fuel-burning central stations, is developed from natural gas.

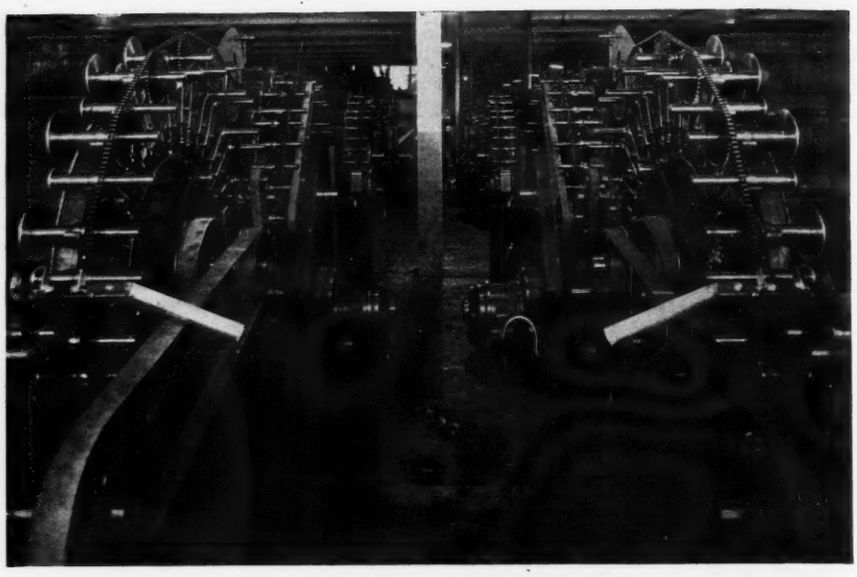
OBITUARIES

GEORGE F PAGE, 94, founder of the Page Belting Co, Concord, N. H., died in that city recently.

REGINALD I MOWRY, 37, plant engineer of Butler Hospital, Providence, R. I., died recently following an operation. He was born in Providence in 1902, and following a training course with the General Electric Co, served as plant engineer with several companies.

JOHN L GREEN, 65, president of Laclede-Christy Clay Products Co, died at St. Louis, his home, in March. He became president of the company in 1911, having entered the organization in 1900 following graduation from Princeton University. Mr. Green is credited with starting the Laclede-Christy research department, the first to be established by manufacturers of refractories. He has been succeeded in the presidency by W J Westphalen, former vice-president and general manager of the company.

JAMES D ROSS, 66, administrator of the Bonneville Dam project in Oregon on the Columbia River, died March 15 at the Mayo Clinic in Rochester, Minn. As administrator of the Bonneville project, Mr Ross had charge of the greatest potential hydroelectric power system in the world. Mr. Ross was also superintendent of the municipal power system of Seattle, which he developed almost from its start. He served as advisory engineer on power for the Public Works Administration from 1933 to 1935 and was subsequently appointed by President Roosevelt to the Securities and Exchange Commission to handle the registration of utility holding companies. He was born in Chatham, Ont., and had little formal schooling. In 1903 he became the superintendent of the Seattle Municipal Light and Power Commission and planned the Skagit project on the Skagit River, where Seattle's power is generated.



WOOLY DRIVE

10-hp, 350-rpm gearmotors drive woolen cards at a large textile mill. Special screens prevent lint from entering motors, which pass "quietness" tests before installation

PERSONALS

W H TAUBERT, for the past 8 years sales manager of the Insulating Div, Corning Glass Works, Corning, N. Y., has joined the Phelps Dodge Copper Products Corp, Sales Dept, N. Y.

MAJOR P J COWAN, who has been associated with the editorial department of *Engineering* (London) for the past 30 years, has retired from the position of editor. He will be succeeded by Charles Cooper, and J F Petree, who have been appointed joint editors.

GEORGE H HELFRICH, associated with Reading Pratt and Cady Div, American Chain & Cable Co, Inc, since 1925, has been appointed District Sales Manager of the company. He will have his headquarters at 400 West Madison St, Chicago, Ill.

J G MINGLE, 4221 Boulevard Place, Indianapolis, Ind., is opening an office to conduct consulting engineering in the field of chimney and draft problems. He is a graduate of Purdue University and has had 25 years experience in the field.

GEORGE T POWER, for the past 55 years a member of the sales staff of the Scovill Mfg Co, 280 Broadway, New York, N. Y., has retired from his position as district manager. He was born in Portland, Me., and joined the company at the age of 20, as clerk in the Boston office. In 1888 he was transferred to the Chicago office, where he continued as a salesman until 1906. After a period of 13 years as a salesman in mill products, he assumed charge of the brass and brass goods division of the New York office, the oldest branch office of the company. For the past 15 years he has headed that office as district manager.

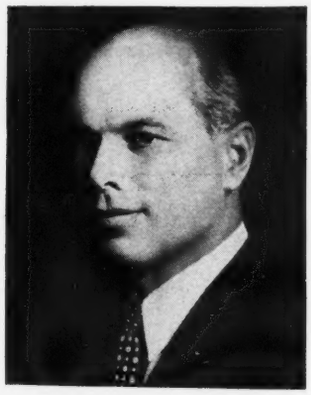
A C HANSON, connected with Foote Bros Gear and Machine Corp, has been appointed District Representative and Sales Engineer of the Detroit territory, succeeding E G Akridge. Mr Hanson formerly handled the Northern Indiana and Southern Michigan territory for the company.

DAVID DASSO, vice-president of the American Locomotive Co, Diesel Engine Div, resigned that position on April 1. He will remain with the company in a consulting capacity and will continue as U. S. representative of Sulzer Bros, Ltd, Winterthur, Switzerland.

H P DOLISIE, of Montreal, Canada, and Henry Booth, of New York, were elected president and vice-president, respectively, of the International Acetylene Association. H F Reinhard, of New York, was reelected secretary. Mr Dolisie was born and educated in France and was decorated for bravery during the World War with the French War Cross. He joined Societe L'Air Liquide of Paris, manufacturers of welding supplies and equipment, and a year later came to Canada as assistant manager of the Canadian Liquid Air Co, Ltd. In 1934 he took up his present position as managing director of that com-

pany. Mr Booth and Mr Reinhard are associated with Shawnigan Products Corp, and Union Carbide Co, New York, respectively.

JAMES H ROBINS was elected president of the American Pulley Co, Philadelphia, Pa. and to membership in the Board of Directors of that company. He will be in



James H Robins

active charge of the company's affairs, replacing C E Brinley, who resigned to accept a position as president of the Baldwin Locomotive Works.

CHESTER P GROSS, formerly superintendent and general manager of the Municipal Water and Electric Depts of Wisconsin Rapids, Wis., has been appointed vice-president of the Albertson Electric Co of Milwaukee, in charge of sales. Following graduation from the University of Wisconsin he entered the employ of the railroad commission of Wisconsin. From 1912 to 1916 Mr Gross supervised and managed municipal and private utilities in Nebraska City, Neb., and Reedsburg, Wis. He was president of the Wisconsin Municipal Utilities Association in 1924 and 1925, and chairman of the Wisconsin Section of the American Water Works Association in 1923.

MAX W BABB, president, Allis-Chalmers Mfg Co, Milwaukee, Wis., was recently honored by being conferred the degree of doctor of laws by Iowa Wesleyan College at Mount Pleasant, Iowa. The honorary degree was presented by Dr Stanley B Niles, president of the college. Dr Babb is an alumnus of both Iowa Wesleyan and the University of Michigan.

BUSINESS ITEMS

ALLIS-CHALMERS MFG CO, Milwaukee, Wis., announces change of address of Shreveport, La., office from 712 Ardis Bldg to 611 City Bank Bldg. L G Park remains as representative in charge.

KENNEDY & VAN SAUN MFG & ENGINEERING CORP, New York, N. Y., recently completed shipment of four 8-ft diameter x 14-ft long, and eight 10-ft diameter x 15-ft long, Kennedy integral gear-driven, air-swept tube coal mills. This order is believed to be the largest ever placed for coal pulverizers, and the 10 x 15-ft mills the largest pulverizers ever built for grinding coal to fire boilers.

HEWITT RUBBER CORP, Buffalo, N. Y.. is celebrating 80th anniversary of the founding of Gutta Percha & Rubber Mfg Co, Hewitt parent company. Hewitt Rubber Corp manufactures welding hose, synthetic rubber gasoline pump hose, and other rubber products. Thomas Robins, Jr, is president of the company.

E KEELER CO, Williamsport, Pa., established during the closing period of the Civil War, is celebrating its 75th year of service. The company builds boilers and recently introduced a new steam generator on which the U S Patent office allowed 24 claims.

WARD LEONARD ELECTRIC CO, Mt. Vernon, N. Y., announces change in address of its Philadelphia office, which will be at 1600 Arch St, Room 329. Frank Beede, formerly of Chicago office, is district manager. William M Tompkins and Lester B. Free, former representative at Philadelphia, complete the organization.

STRAWS

Pointing the way business winds blow

ALABAMA——Construction Service, Veterans' Administration, Washington, D. C., will receive bids until May 16 for boiler plant and pumping station at institution at Montgomery. Also bids for boilers and boiler-plant equipment, refrigerating apparatus, radial-brick stack, one elevated steel tank and tower, capacity about 100,000 gals., air-conditioning system, and electric elevators.

Tennessee Coal, Iron & Railroad Co, Birmingham, plans improvements in iron-mining properties at Red Mountain near Bessemer, with new ore-crushing and handling equipment, and sintering plant, including modernization of present facilities. Cost about $600,000.

ARIZONA——Phoenix Union High School and Junior College District, Phoenix, will begin work soon on central-heating plant at new junior college. Cost over $90,000. Lescher & Mahoney, Title & Trust Bldg, Phoenix, architects.

Dept of Interior, Indian Service, Washington, D. C., has low bid of $96,400 from Gates & Huntley, 2020 Hyperion Ave, Los Angeles, Cal. for central-heating and power plant at Navajo Indian Agency, Fort Defiance, and will make award soon.

Meetings

American Institute of Electrical Engineers —*Combined Summer and Pacific-Coast Conventions, June 26–30, San Francisco, Calif. H H Henline, secretary, 33 West 39th St, New York, N. Y.*

American Society of Heating and Ventilating Engineers—*45th Semi-Annual Meeting, July 2–5, Grand Hotel, Mackinac Island, Mich. A V Hutchinson, secretary, 51 Madison Ave, New York, N. Y.*

American Society of Mechanical Engineers —*Oil and Gas power Division Meeting, June 19–22, Ann Arbor, Michigan. Also, Semi-Annual Meeting, July 10–14, San Francisco, Calif. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

American Society of Refrigerating Engineers —*26th Spring Meeting, May 22–23, Hotel Hershey, Hershey, Pa. Headquarters office, 37 W 39th St, New York, N. Y.*

National District Heating Association — *Annual Meeting, June 27–30, Hotel Pennsylvania, New York, N. Y. W H Sanford, secretary, 1317 Spruce St, Philadelphia, Pa.*

Smoke Prevention Association—*33rd Annual Convention, June 13–16, Hotel Schroeder, Milwaukee, Wis. C D Behan, publicity director, SPA, City Hall Square Bldg, Chicago, Ill.*

Stoker Manufacturers Association—*Annual Convention, June 1–2, French Lick Springs, Ind. Assn headquarters, 307 N Michigan Ave, Chicago, Ill.*

CALIFORNIA——H N Royden, 12725 Weddington St, North Hollywood, plans 1-story ice-manufacturing plant at 1407 Georgia St, 40x75 ft. Cost $25,000. Niles Werner, 257 South Spring St, Los Angeles, engineer.

United Air Lines, 221 North LaSalle St, Chicago, Ill., plans new aircraft repair and maintenance shops near airport at Oakland, including power house. Cost close to $500,000 including machinery and power equipment. Shops will be removed from Cheyenne, Wyo., to new location.

Bd of Regents, University of California, Berkeley, contracted Walter S Leland, 55 New Montgomery St, San Francisco, for watertube boiler at $22,665 for power house at branch of College of Agriculture, Davis.

Taft Union High School and Junior College District, Taft, plans bids for central-heating plant at high school, to include two boiler units. Franklin & Kump, Haberfelde Bldg, Bakersfield, architects.

Louis Mark & Co, 200 5th Ave, New York, N. Y., plans 1-story addition to mechanical-toy-manufacturing plant at Glendale, near Wheeling, W. Va. Cost about $150,000 with machinery.

Bureau of Yards and Docks, Navy Department, plans power house at direction finder station, Point Arguello. Fund is being arranged in navy public works bill.

Northrop Aircraft, Inc, 6824 McKinley Ave, Los Angeles, John K Northrop, president, plans airplane-manufacturing plant near airport at Long Beach, where large tract of land has been acquired. Several 1-story units will be built, totaling 100,000 sq ft of floor space, with power house. Cost close to $450,000.

Southern California Gas Co, 810 So Flower St, Los Angeles, has authorized fund of $4,300,000 for improvements in artificial-gas-plants and systems during 1939, including additional equipment, storage and distribution facilities pipelines, etc.

Bureau of Yards and Docks, Navy Dept, Washington, D. C., plans power house at naval destroyer base, San Diego. Cost about $50,000. Appropriation being arranged.

Bd of Harbor Commissioners, Ferry Bldg, San Francisco, will contract soon for cold-storage and refrigerating machinery for plant at Berry St and Embarcader. Frank G White, address noted, engineer.

Arrowhead Springs Corp, Arrowhead Springs, plans boiler plant at 5-story hotel, to replace structure destroyed by fire. Erection will begin this spring. Cost over $1,000,000. Gordon B Kaufmann, 627 South Carondelet St, and Paul R Williams, 3839 Wilshire Blvd, Los Angeles, architects.

Bd of Directors, Imperial Irrigation District, El Centro, has low bid from R G Clifford, 215 Market St, San Francisco, at $283,906.25 for hydroelectric plant on All-American Canal, near Calexico. Award will be made soon.

Hercules Powder Co, Delaware Trust Bldg, Wilmington, Del., plans addition to branch plant at Hercules, Cal., consisting of several 1-story units for production of synthetic ammonia. Cost reported about $500,000.

COLORADO——State Dept of Public Buildings Capitol Bldg, Denver, will take bids for power plant on Sherman St, near 14th St, for service for group of capitol buildings. Will also build 1-story shop on adjoining site. Cost about $300,000. Gordon D White, 615 Columbine St, Denver, architect.

CONNECTICUT——State Dept of Public Works, State Office Bldg, Hartford, plans call for bids for central-heating plant at institution at Storrs, including boiler units and pumps. Cost close to $150,000. Engineering dept in charge.

New Britain has engaged Louis T Klauder, Lincoln-Liberty Bldg, Philadelphia, Pa., consulting engineer, to make surveys and estimates of cost for proposed municipal electric plant.

FLORIDA——Bd of Commissioners of State Institutions, Capitol Bldg, Tallahassee, will contract for boiler unit, cold-storage and refrigerating machinery for state hospital at Chattahoochee. W B Cone, secretary.

GEORGIA——National Biscuit Co, 449 West 14th St, New York, N. Y., plans baking plant at Murphy and Arden Aves, Atlanta, where 35 acres have recently been acquired. Main unit will be 1-story, 300x900 ft, with traveling ovens, conveyors. Boiler house also planned. Cost close to $2,000,000. Louis Wirsching, company architect.

Fourth National Bank, Columbus, Ste-

wart Fleming, president, will have plans prepared soon for air-conditioning plant and system in office building. Estimates being made.

IDAHO——Bd of Trustees, University of Idaho, Moscow, plans improvements in power house at institution, including new boiler unit. Cost about $90,000. Appropriation authorized and engineer will be engaged soon to prepare plans and ask bids.

ILLINOIS——Winnebago Distillery Co, 105 West Monroe St, Chicago, has authorized construction of plant near Elgin, consisting of group of 12 buildings, with power house, and will make awards for machinery and power equipment soon. Cost about $750,000. Paul Gerhardt, Sr, 457 West Fullerton St, Chicago, architect.

Swift & Co, Union Stock Yards, Chicago, plans 1-story processing and packing plant at 4th Street South and Connecticut St, Seattle, Wash., 150x320 ft with large cold-storage and refrigerating plant. Cost about $250,000. Company engineering dept, first noted address, in charge.

Constructing Quartermaster, Chanute Field, will make award soon for installation of steam-distributing system at local field.

Bd of Education, 228 North LaSalle St, Chicago, plans central-heating plant in 3-story and basement junior college building on Stewart Ave, near 68th St. Cost over $1,500,000. John C Christensen, address noted, architect.

Stephenson County Farm Bureau, Lena, plans addition to cold-storage and refrigerating plant, with locker system to provide about 400 additional units. Cost reported over $25,000. Ray Farrington, chairman of committee in charge.

Victor Chemical Works, 141 East Jackson Blvd, Chicago, plans improvements in phosphate plant at Mount Pleasant, Tenn., including production units for large increased capacity. Cost about $850,000. Will also improve acid works at Chicago Heights, to cost about $150,000. Financing has been arranged.

C H Armstrong, Rockford, plans rebuilding portion of cold-storage plant on East State Rd, about 6 miles from city, recently damaged by fire. Loss reported about $25,000.

INDIANA——Kentucky Natural Gas Corp, Vincennes, has purchased properties of Universal Gas Co, at Bloomington, Greencastle Columbus, Bedford and Seymour, and plans extensions in pipeline system for natural-gas service in these communities, heretofore furnished with mixed gas. Control stations and other operating facilities will be installed.

Delaware County Housing Authority, Muncie, plans central-heating plant in local housing development. Cost about $500,000. To begin work soon. Graham & Knowlton, Security Trust Bldg, Indianapolis, architects.

Kokomo Housing Authority, Kokomo, plans central-heating plant in housing development of 175 dwellings. Bids will be asked soon. Cost about $750,000. Graham & Knowlton, Security Trust Bldg, Indianapolis, architects.

IOWA——Henry Hackert, Oskaloosa, operating Hackert Hatchery, has acquired 1-story industrial building at 601 High Ave West, and will remodel and equip for new cold-storage and refrigerating plant, with locker system. About 250 lockers will be installed for initial service, with about 150 additional lockers at later date. Cost close to $40,000.

Montezuma is considering municipal electric plant and distributing system. Cost about $135,000. To hold special election to vote bonds.

Ralph D Thomas & Associates, Minneapolis, Minn., are making preliminary surveys and studies on improvements to municipal light and power plant at Hampton. Will include Diesel-generating units.

KANSAS——Larned contracted General Electric Co, at $42,940 for 1500-kw steam turbine-generator unit for municipal electric plant. Also made award to Worthington Pump & Machinery Corp for 3000-sq-ft surface condenser. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

Bucklin plans natural-gas distributing system, with main welded-steel pipeline for connection with supply source, control station and other operating facilities. To arrange bond issue.

Greensburg plans municipal natural-gas distributing system, with control station and other operating facilities. Special election will be held soon to vote bonds. W L Woods, mayor, in charge.

KENTUCKY——Bd of Education, Lex-

(Continued on page 154)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Calif., Long Beach—Northrop Aircraft, Inc., J. Northrop, pres., 6824 McKinley Ave., Los Angeles, plans constructing airplane factory on 20 acre site adjoining municipal airport. $500,000.

Conn., New Britain — City, G. J. Coyle, mayor, City Hall, preliminary survey constructing municipal power plant. To exceed $40,000. L. T. Klauder, Lincoln-Liberty Bldg., Phila., Pa., engr.

Ga., Atlanta — National Biscuit Co., 681 Whitehall St. S.W., plans constructing 1 story, 330x900 ft. bakery, Murphy and Arden Aves. S.W. $2,000,000. L. Wirsching, 449 W. 14 St., New York City, archt.

Ill., Chicago—Howard Aircraft Corp., B. O. Howard, pres., 6644 S. Whipple Ave., making plans constructing 1 story, 120x550 ft. factory. $150,000. Private plans.

Ia., Duncombe—Bids May 12, by Town, constructing municipal power and electric light distribution system and auxiliary equipment. J. W. Brown, town clk.

Ia., Hartley—Bids Apr. 25, by City, constructing addition and improvements to light plant, furnishing, installing diesel engine generating unit.

Ia., Montezuma—City voted $136,000 bonds, constructing municipal light plant.

Ia., Sibley—Bids Apr. 26, by City, constructing power plant and power building improvements, Sects. 6 to 10 (inclusive), boiler and accessories, feed water pump, heater, vacuum pump, water softener, power plant piping, pipe covering and insulation extensions, foundation for equipment, etc. $150,909. PWA.

Kan., Kansas City—City, plans by J. W. Radotinsky, Commercial Bank Bldg., constructing 1 and 2 story, 140x360 ft. cold storage building in connection with Food Terminal Project. $660,000. Maturity soon. W. F. Schulz, Shrine Bldg., Memphis, Tenn., engr.

La., Ville Platte—Continental Oil Co., Ponca City, Okla., final plans made constructing 25,000,000 cu. ft. per day natural gasoline plant and crude oil desalting plant, near here. $500,000. Private plans.

Mich., Ann Arbor—King Seeley Corp., 1 St., plans by Giffels & Valley, Inc., 1000 Marquette Bldg., Detroit, constructing 5 story, 60x120 ft. concrete, brick plant addition. $160,000.

Minn., Alexandria—Bids May 1, by City, constructing power plant and building addition. Total est. $162,465. PWA. Burlingame, Hitchcock & Estabrook, 521 Sexton Bldg., Minneapolis, engrs.

Minn., Halstead—Bids Apr. 25, by A. Opgrand, village clk., constructing electric power plant building, generating equipment, distribution system. To exceed $40,000. G. M. Orr & Co., 542 Baker Arcade Bldg., Minneapolis, engrs.

Miss., Clarksdale — Bids May 2, by Mayor and Bd. Aldermen, constructing alterations and additions to municipal power plant, incl. general construction, boiler, erection and settings, auxiliary equipment, piping, electric wiring, coal handling and storage equipment, conversion of turbine and auxiliaries new steam condition. $100,000 funds available. Stevens & Johnson, Starkville, engrs.

Mo., Eldorado Springs—Bids Apr. 27, by City, installing two 300 hp. generating units, constructing power plant building, $90,000; extending distribution system, $9,000; and constructing white way system. PWA. W. B. Rollins & Co., Railway Exch. Bldg., Kansas City, Mo., engrs.

Mo., Pleasant Hill—Bids Apr. 25, by City, furnishing, installing 3 unit generating plant, approximately 1,000 hp. capacity, and brick building to house same, $115,000; extending distribution system, $12,000. PWA. W. B. Rollins & Co., Railway Exch. Bldg., Kansas City, Mo., engrs.

Neb., Wymore — City plans constructing power plant improvements. $150,000. E. H. Dunmire, 1802 B St., Lincoln, engr.

N. H., Rumney—L. L. Bunker, town clk., Town Hall, plans constructing electric light and power plant. Engineer not appointed.

N. J., Camp Dix—Con. Q.M., improving electric power houses, motor repair shop, etc., at Camp Dix, WPA labor. $150,000.

N. Y., Lockport—Niagara, Lockport & Ontario Power Co., Electric Bldg., Buffalo, plans constructing power plant. Est. exceeds $150,000. Maturity later in 1939. Private plans.

N. Y., Watertown—Central New York Power Corp., Watertown, plans extending and improving gas and electric facilities in Jefferson, St. Lawrence, Franklin and Lewis Counties, incl. power plant and equipment improvements. $1,326,000. R. W. Porter, vice pres., in charge.

N. C., Cullowhee—Western Carolina Teachers College, Dr. H. T. Hunter, pres., rejected bids Mar. 18, constructing boiler plant improvements. $18,000. PWA. Will readvertise. Wiley & Wilson, Lynchburg, Va., engrs.

N. C., Elkin — Chatham Mfg. Co., T. Chatham, pres., plans constructing plant addition, 145,000 sq. ft. floor space, overlooking Main St. $500,000. Maturity May 1.

O., Cleveland—Cleveland Graphite Bronze Co., J. J. McIntyre, genl. mgr., 880 East 72 St., plans constructing brick, steel, concrete factory buildings. $500,000. Site selected soon. Architect not appointed.

O., Cleveland—Willard Storage Battery Co., c/o P. J. Voth, constr. engr., plans constructing 2 story, 40x300 ft., brick, steel, concrete factory addition. $125,000. Private plans.

O., Massillon and Warren—Republic Steel Corp., Republic Bldg., Cleveland, plans constructing plant improvements at both plants. $1,000,000. Private plans.

O., Painesville—City plans constructing light plant improvements. $38,320. C. S. Fullerton, city engr.

Okla., Kaw City—State Bd. Affairs, Oklahoma City, made preliminary plans constructing flood control and hydro project here. $1,000,000. C. A. Stoldt, Oklahoma City, engr.

S. C., Abbeville—Bids Apr. 28, by City, hydro-electric power house equipment, one 2,750 kva. and one 1,000 kva. hydro-electric generator with water wheels, switchboard, completion dam, spillway and water gates. $342,520. PWA. Wiedeman & Singleton, Candler Bldg., Atlanta, engrs.

Tex., Austin—Bids Apr. 28, by Lower Colorado River Authority, F. Engelhard, chn., 806 Littlefield Bldg., Austin, furnishing turbines, governors and generators for power plant at Marshall Ford Dam. C. McDonough, Littlefield Bldg., mgr.

Tex., Muleshoe—Chickasha Cotton Oil Co., Chickasha, Okla., plans constructing 1 and 2 story, brick, concrete, fireproof cotton oil mill plant, 20,000 tons capacity, on 20 acre site. $100,000. Site purchased. Private plans.

Wisconsin—Public Service Corp., 1029 North Marshall St., Milwaukee, Wis., the 1939 construction budget totals $1,456,000 incl. development at Grandfather Falls $130,000, changes in hydro electric plants $57,000, improving steam electric plants $14,000, transmission line improvement $70,000, substation additions $160,000, gas plant and gas distribution addition $145,000, miscellaneous improvement $130,000, new electric distribution lines $750,000, of which about $400,000 for new rural lines.

Wyo., Rock Springs—Union Pacific Coal Co., 15 and Dodge Sts., Omaha, Neb., making plans constructing power plant. Construction will be done by day labor. Furnishing, installing boilers, 7,500 kw. turbo-generator, will be by contract. Will not be ready to ask bids on outside work for some time. $500,000. Private plans.

Ont., Fort Erie—Fort Erie Terminals Ltd., A. S. Towers, secy., c/o Pilot Securities Ltd., 68 Yonge St., Toronto, made plans constructing 2,000,000 bushel grain elevator. $500,000. J. H. Tromanhauser, 901 Federal Bldg., Toronto, engr.

Ont., Malton—Canadian Associated Aircraft, Ltd., Toronto (Malton), bids soon constructing factory extension at airport. $350,000.

Ont., Ottawa—Dpt. P. Wks., Ottawa, made plans constructing power house, pump house equipment and machine shop at Lorne Dry Dock. $100,000 voted.

Ont., New Toronto—Canadian Industries Ltd., 1135 Beaver Hall Hill, Montreal, Que., making plans reconstructing fabrikoid plant and addition to solvent recovery system. $150,000. Private plans.

Ont., Thorold—Ontario Paper Co., Ltd., A. A. Schmon, pres., plans constructing plant addition, Allenburg Rd. $150,000. L. C. Anderson, c/o owner, engr.

Ont., Toronto—Willys of Canada, Ltd., Windsor, plans constructing assembly plant. $150,000. Negotiating for site.

Que., Levis—J. M. Somerville, secy. Dpt. P. Wks., Ottawa, Ont., soon takes bids constructing power house, pump house equipment and machine shop, Lauzon St. $100,000. C. D. Sutherland, archt., and K. M. Cameron, engr. both c/o owner.

Que., Montreal—Canada Northern Power Co. Ltd., 355 St. James St., plans nearing completion completing hydro-electric development on Quinze River, Abitibi Co., increasing capacity to full available head of 90 ft., raising dams, etc. present head 70 ft. $2,000,000. Private plans.

Que., Montreal—Canadian Industries Ltd., 1135 Beaver Hall Hill, plans reconstructing paint plant, St. Patrick St. $300,000. Maturity in summer.

Que., Montreal East—Canadian Copper Refiners Ltd., H. S. MacKnight, mgr., plans constructing refinery addition, Durocher St. $150,000. G. Pradi, Noranda Mines Ltd., Royal Bank Bldg., Toronto, engr.

Old demon Dust is all
stretched out
Just havin' lots of fun.
These horizontal
contacts prone,
Can't shake the dirty bum.

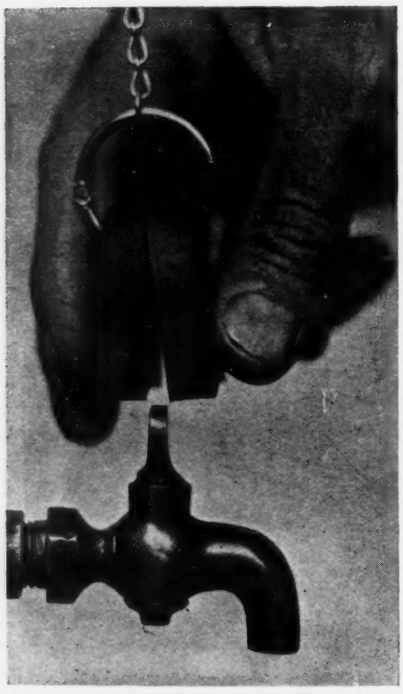
They have to cook and
fry and roast.
That is their sordid fate.
**Had they been built
to work upright,
A longer life they'd rate.**

VERTICAL CONTACTS mean better Motor Control. Dust between contacts causes heating and burning. But dust *can't* settle on VERTICAL contacts. So Cutler-Hammer VERTICAL CONTACTS need not be buried. They are *out in the open* . . . always air-cooled, easily inspected, fully accessible—yet free from dust and dirt. Get the facts. Send for free book, "Dust, the Destroyer." CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers,* 1358 St. Paul Ave., Milwaukee, Wisconsin.

ONLY VERTICAL CONTACTS CAN BE DUST-SAFE!

CUTLER-HAMMER
MOTOR CONTROL
C-H

Practical Aids to Operation



Rubber Heels Turn Small Drain Cocks

SMALL DRAIN COCKS and valves with tapered plugs are often hard to turn with the fingers. They must, of course, be kept reasonably tight. When hot, they are quite uncomfortable to the fingers, even with heavy gloves protecting the hand.

Two small tough rubber heels placed on an ordinary loose-leaf ring, which is attached to an inexpensive key-ring chain, does the trick very nicely. A small drill may have to be run through the top nail hole of the heel to enlarge it. Curve of the ring keeps the wide portions of the heels spread a trifle, ready for use. The heels protect the fingers and afford a much better grip.

Clinton, Iowa FRANK BENTLEY

Sealing Wax as Soldering Flux

COMMON red sealing wax is an excellent flux for soldering copper and brass articles that have been well cleaned. The most convenient way of applying it is to crush to a powder and use in the same way as rosin. It also has the advantage of being non-corrosive and non-conductive so that any wax left in a joint will do no harm later.

Nashville, Tenn. T E MILLER

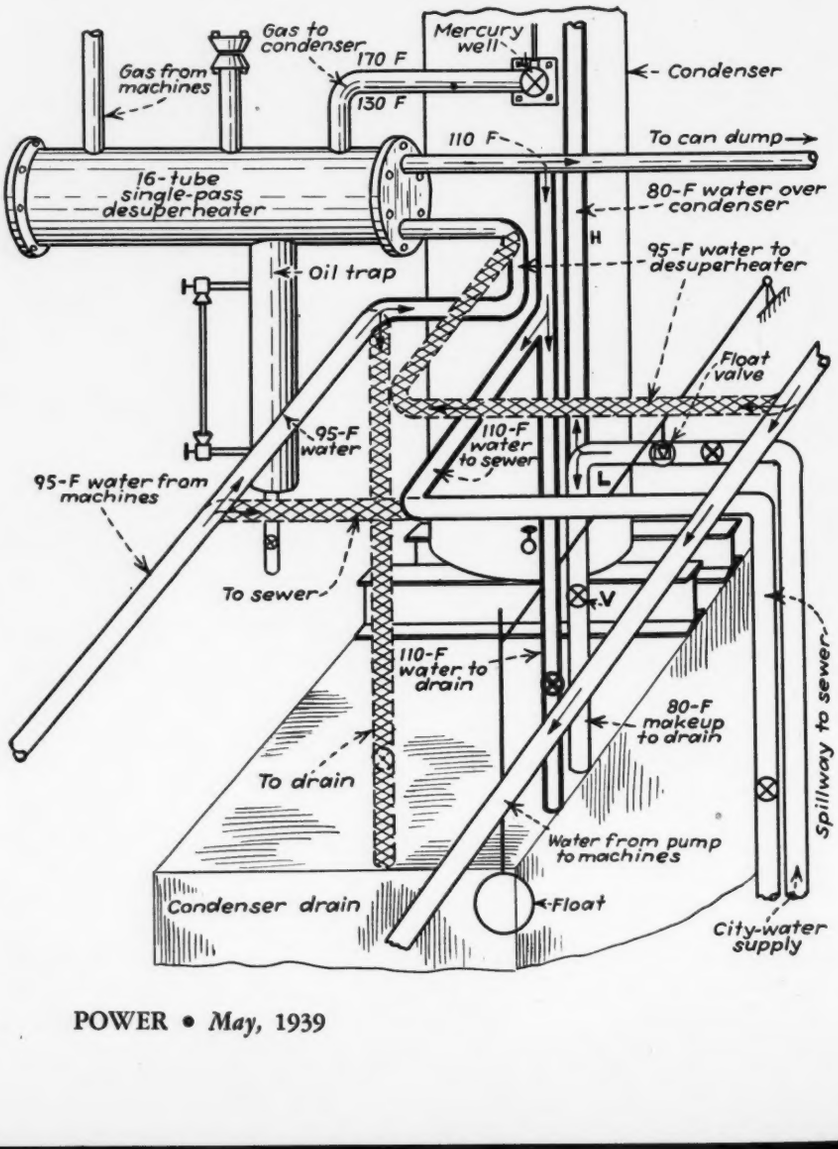
Making Water Do Double Duty

CONFRONTED in a new cold-storage and ice plant, at the height of the season, with discharge ammonia pressures exceeding 200 lb, we were compelled to use an excessive amount of 80-F city water. On hot, still days, with the wet-bulb thermometer reading almost as high as city-water temperature, the natural-draft cooling tower proved unequal to the load. Water from the condenser drain, after circulating through the machine jackets, as shown in the diagram, was spilled to the sewer at 95 F. Amount of water varied from 1000 to 5000 gph, as needed to keep head pressure down.

For two hours each morning the can dump used water for thawing, heated to approximately 110 F by the desuperheater. This kept discharge pressure down while harvesting and reduced temperature of gas entering the condenser to 130 F. At the end of the day's harvest the desuperheater was, because of the piping arrangement, practically cut out of the system and gas temperature to the condenser rose to 170 F.

Since makeup water entered the condenser drain directly without passing over the condenser, much of it was spilled to the sewer after only a slight temperature rise in the machines. A fan was recommended for the cooling tower, but could not be obtained.

These conditions brought about the rearrangement of the piping system shown in the diagram. Pipes shown shaded were removed and those indicated by heavy black lines were installed. Instead of returning directly to the drain, water from the machines is passed through the desuperheater. From there it can be sent to the can dump, spilled or simply returned to the condenser drain. This arrangement has the added advantages of condensing and trapping off more oil from the gas, preventing oil films on the condenser tubes and evaporator coils from reducing heat transfer and reducing



Selected for Union Pacific's New G.E. Steam-Electric Locomotive

FACTS ABOUT THIS NEW LOCOMOTIVE

A modern oil-fired Babcock & Wilcox boiler which is controlled automatically by equipment supplied by The Bailey Meter Co., furnishes 1,500 lb. steam at 850 deg. F. for two 2,500 h. p. G. E. geared turbine-electric generators supplying current for 12 drive motors capable of maintaining train speed of 125 miles per hour.

YARWAY Impulse Steam Traps

Used on Turbine Drain and Circulating System

U. P.'s newsworthy steam-turbine-powered electric locomotive rolled, a few weeks ago, from General Electric's Erie Shops — is expected to get double value out of each pound of fuel and triple normal mileage between fuel stops.

On this innovation in locomotives is a similarly novel design of steam traps — the Yarway Impulse Trap, found adaptable for this special service.

General Electric's attention was drawn to this trap, no doubt, through their use of several hundred Yarway Traps in industrial services in their various plants.

Have you investigated this trap about which one after another user says, "equipment gets hotter, sooner," — "saves fuel," — "saves space," — "easier and cheaper to install," — "we like its flexibility on different pressures," — "cheaper to replace with Yarways than to repair old-type traps," etc., etc.

More than 50,000 Yarway Impulse Traps are already in service and orders this year are at an all-time high level—as satisfied users call for more and more.

End your trap troubles. Ask for Bulletin T-1734 or see your local mill supply distributor.

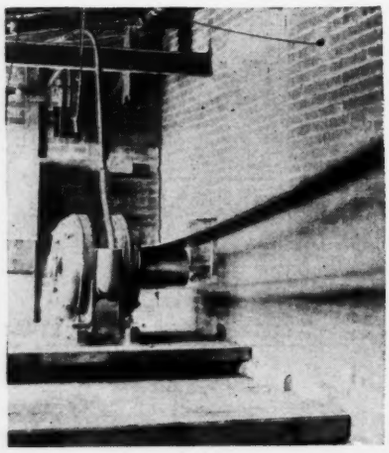
YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

YARWAY IMPULSE STEAM TRAP

the condenser load. Water spilled to the sewer at 30 F higher than the city water, when head pressure is high, we consider well wasted.

When all compressors were started simultaneously, discharge pressure often became excessively high before the water drawn from the condenser drain reserve and makeup by the pump could be circulated over the tower and returned from the weir to the condenser. To eliminate this trouble and also to gain full cooling effect of the makeup water, the elbow at *L* was removed and a tee installed. In hot weather when city water is cooler than that from the tower, valve *V* is closed and the makeup directed over the condenser by way of newly installed pipe *H*. Entering and leaving the plant, the water is now compelled to carry its maximum thermal load, we believe. Doubtless the economy of many plants could be improved by similar small changes as simple as these.

Marissa, Ill. GEORGE BLUM



Endless Belt Cures Drive Troubles

A 275-HP, 600-RPM synchronous motor drives a line shaft where load fluctuates considerably. The motor pulley is 20 in. in diameter and the shaft pulley is 86 in. with a face width for a 22-in. belt. Several different belts were tried on this drive without success, until an endless 2-ply leather belt was put on the drive and has now been in service about 9 years with practically no trouble. The only maintenance required has been an occasional dressing with a compound recommended by the belt manufacturer and, of course, cleaning.

In several places about the plant where leather belts are used, trouble has been caused by dusty conditions. Dressing used on the belts makes dust stick to both faces. It is easy enough to wipe off the outer surface when the belt is in motion. On the inner surface, dust accumulates and gradually builds up on the pulley in a sticky, tarry-like mass. If this dirt is allowed to accumulate, bumps form that have a tendency to cause the belt to vibrate, or in extreme cases the belt may be caused to run partially off the pulley under load. This tarry substance can easily be scraped off the pulley with an ordinary pocket knife.

On one drive where the pulley had to be scraped at least once a week, an enclosure was built about the belt and pulley, after which the belt seldom needed attention. Dust not only causes trouble by building up on a pulley, but when allowed to stay on the belt, acts as a sponge to suck out the dressing. Then, when the belt is wiped off and another coating of dust gathers, more dressing is required. The only remedy is to keep applying more dressing, which in turn gathers more dust. It is therefore best, where leather belts are used under such conditions, to have the drive inclosed so that the dust cannot get to them. In one case, a motor was installed in a separate room from the dusty process, as in the photo, and is belted to a pulley on the end of the line shaft that extends through the motor-room wall.

Sayreville, N. J. K B HUMPHREY

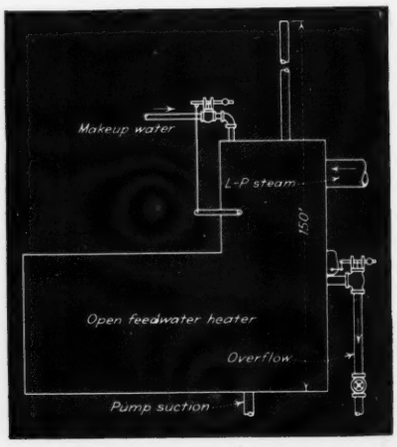
Small-Parts Vise

A VISE for securely holding small parts while working on them is a necessary tool to any repair man, machinist or engineer. I have one like that shown in the figure. It is made from a piece of tool steel, 0.5x1.5 in. in cross-section and 5 in. long. The center is drilled and filed out and then the end is split for the jaws. A working screw is tapped in one side and a clearance hole made in the other. The tool can be used as a hand vise or gripped in the regular bench vise.

Penacook, N. H. C H WILLEY

An Atmospheric Vent That Wasn't Atmospheric

CAST-IRON, open feedwater heaters of the conventional type are often constructed for a maximum working pressure of 15 lb per sq in. A vent line on the heater removes oxygen and steam, and also prevents excessive pressure building up in the heater. Where there is a large-diameter vent straight to atmosphere, with no intervening valves, seldom is it thought possible for trouble from excess pressure to occur in the heater. A safety valve is often dispensed with when the open vent is used. This was the belief in one plant

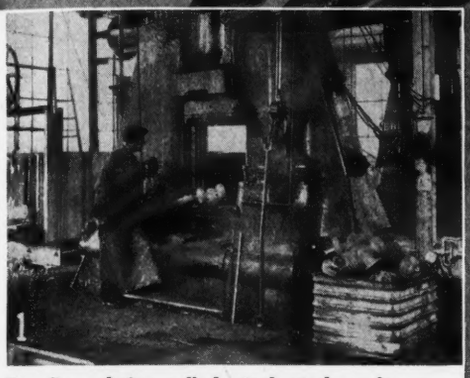


until the heater cracked open and was ruined.

The heater was in a basement boiler room of a 12-story office building and it was necessary to exhaust the vent at the roof, a height of about 150 ft, as shown in the figure. In operation of the heater, the overflow valve was closed accidentally when shutting down for the night. The float valve controlling the supply of makeup water entering at city-service pressure leaked, but as the overflow normally took care of any excess water, nothing had been done about it.

As the steam valve in the heater line was closed, water gradually filled the heater and then rose in the vent line. While the exact head of water that caused failure of the heater will never be known, a static pressure of 65 lb per sq in would have been possible if the vent filled to the top. From this ex-

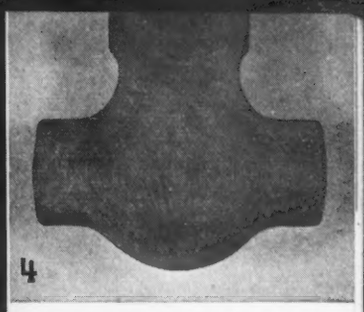
FORGINGS BREED CONFIDENCE



Pounding choice rolled steel stock under a heavy drop hammer increases its density until voids just can't exist. That's why users naturally have faith in valve body forgings.

Forging at high heat develops growth of grain structure — which may be corrected by proper heat-treatment. Edward normalizing furnaces are fired with refinery gas.

From cooling floor, forgings pass to revolving table where steel particles slung at high velocity remove oxidized jacket from heat-treated forging, preparing it for machining.



Sinking a drop forging die is nice work. One test is resultant fibre flow, revealed upon halving the forging.

Modern measuring tools give speed and accuracy when used to check Edward bodies after machining from forgings.

FORGINGS breed confidence. So Edward uses them wherever they are better than castings* or rolled steel. But you can't take forgings for granted until the raw material has survived acceptance tests. And before that, it takes years of study of the problems peculiar to high pressure valves before "specs" can be written wisely. Even when the stock is released for manufacture, after running the Edward testing gauntlet, inspectors hover near to throw out suspicious parts.

* Edward prefers castings for bodies over 2 inch.

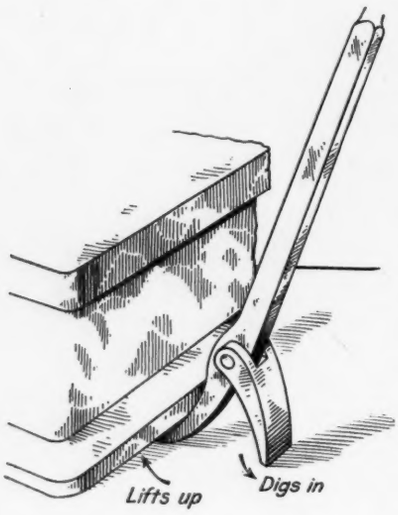
THE EDWARD VALVE & MANUFACTURING CO., INC.
EAST CHICAGO INDIANA

EDWARD VALVES

Stop · Check · Blow-off · Non-return · Feed Line · Relief · Bleeder Line · etc.

perience, it seems good practice to include an open overflow in the vent line at a height where an excessive static load cannot occur. A height of 34.5 ft above the bottom of the heater body would limit the static pressure to 15 lb per sq in.

Boston, Mass. C O DIBBLE



More Power to the Crow Bar

THE TOGGLE design of pry bar in the figure is one that ought to find wide use. We had the shop crew put the toggle or hinged heel on several of our old crow bars. Then we drilled holes in the bars and made the yoked heels. These can be attached or taken off as desired by a pin through toggle and bar.

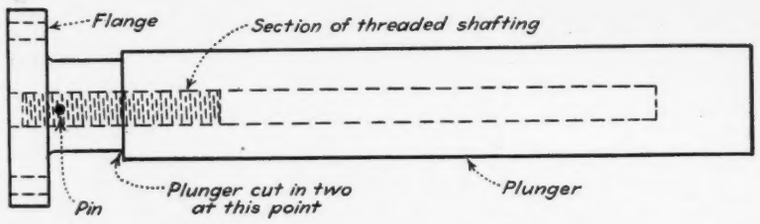
Penacook, N. H. C H WILLEY

Separable Plungers Reduce Overhaul Time

AN OIL company, using duplex tandem pumps for handling crude oil against high pressures, found that in one 7-hour delay to repair a plunger, all but 75 minutes were spent in preliminary and reassembly work which did not actually concern the plunger.

To eliminate this loss of time and tedious realignment work necessary after dismantling a unit, a plunger was sent to a machine shop. The original shrinkage cavity within the plunger was bored out and threaded with a coarse thread. Then, the plunger was cut where the neck section joined the sized portion of the plunger, as in the figure. Into the flange end of the plunger was screwed a threaded section of shafting and pinned with a heavy pin to prevent turning.

This change permitted removal of the plunger without disturbing other



pump parts. When the plunger section had been inserted into the pump barrel, it was easy to screw the flange end with its connecting shaft, into the end of the plunger. With the aid of chain tongs the sections can be joined almost as tightly as a single casting.

After this, it is a matter of a few minutes to locate the flange on the studs in the crosshead, and to complete the repair. After all pumps had been fitted with separable plungers, subsequent repairs were made simply by breaking the joint in the plunger, backing the crosshead enough to clear the threaded end of the shaft, removing the flange end, after which the plunger proper could be slid out freely.

Separable plungers facilitate plunger replacement. They are especially convenient when changing output of a unit by changing diameters of plunger and gland. It is possible to replace only the working portion of the plunger, with one set of flange ends serving for all plunger diameters that exceed the neck-section diameter.

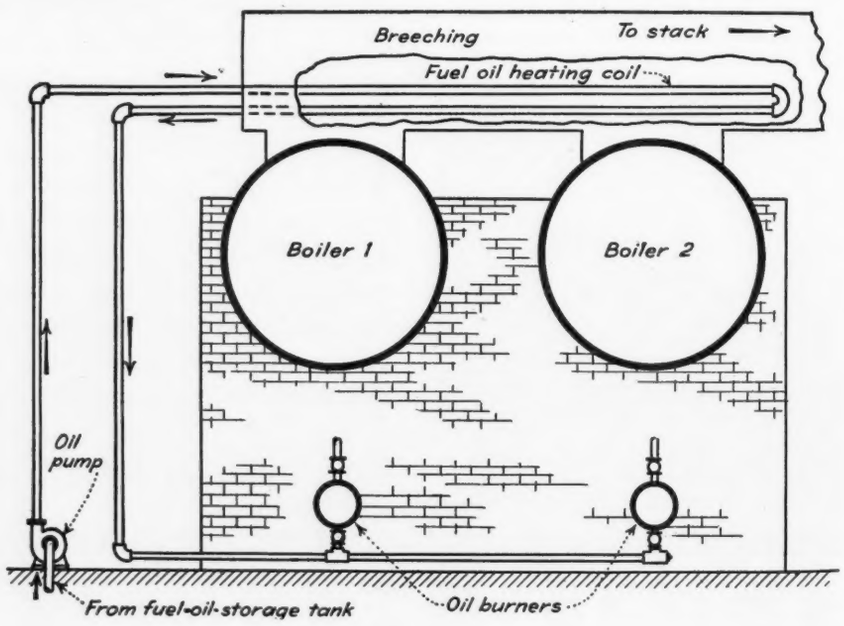
Kilgore, Texas C C LYNDE

Fuel-Oil Economizer With a Hazard

A POWER-PLANT engineer designed and installed a socalled fuel-oil economizer, as indicated in the diagram. Two 15-ft lengths of 2-in. pipe with a return bend were used in the breeching above two hrt boilers. Fuel oil was pumped through this coil to the burners. This arrangement operated very satisfactorily because increased oil flow through the coil to meet greater load demands, was accompanied by higher flue-gas temperature. Results were even better than anticipated. Oil temperature to the burners was brought from 60 to 200 F by waste heat, with a saving estimated at about $100 annually.

The hazard that a generous supply of hot fuel oil might spray into the flue gases at 450 to 650 F should not be neglected. This temperature is well above the flash point of the oil, and a gas explosion might blow the breeching and boiler fronts to pieces if a serious oil leak occurred, or a fire might develop that would prevent entering the boiler house to shut off the oil burners. If a fuel-oil economizer is desired, build it of extra-heavy seamless-steel pipe bent to shape so that there are no threaded connections in the flue. Also, locate this pipe so that its condition may be determined by periodic inspection and hammer test.

Former practice in this plant was to use an electric heater for over an hour until the boiler generated sufficient steam to operate the steam fuel-oil heater. The flue-gas heater has the



Keeps Hot Process Softener Clean

FORMERLY, it took just two weeks for the jet heater on a hot process type water softener in a western plant to completely choke up with scale. Because the temperature of the heater effluent was above the atmospheric boiling point, no satisfactory treatment was found until they used Nalco No. 18. Now the heater stays clean continuously. Scale has also been eliminated in the vent condenser.

Holds Water Stable at 330°F.

HARDNESS of less than one grain per gallon in one plant recently was sufficient to form scale in a closed heater and drop the temperature from 330 deg. down to as low as 290 deg. F. in a week's time. Because such a loss is serious in many modern plants, something had to be done about it. It was: Nalco now keeps the heater clean continuously.

Stop Embarrassing Shut-Downs

FOUR years ago, a prominent hotel put in a large air conditioning system. It worked fine except that each summer it had to be shut down, one or more times (amid complaints of guests) to remove scale from the cooling water system. Last year, they used Nalco treatment. Result: No shut-downs to remove scale.

STABILIZED WATER is big news among plant operating men this year. Many have found that they can almost miraculously rid themselves of some of their most troublesome cleaning jobs: keeping scale out of boiler feedlines, pumps, heaters, economizers, engine cooling jackets, etc.

Stabilized Water, on the other hand, is not new to Nalco. For a number of years, we have been watching it, testing it, and producing it in customers' plants for temperatures as high as 400°F. We will be glad to give you complete information. ***See your local Nalco representative, or write.*** **NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Ill.**

Frees Engineer from Cleaning Job

IN a small plant in Minnesota, the storage type hot water heater has a direct connected coil running through the furnace. In a week's time, the heater and coil would scale up enough for the heater temperature to drop from 170 deg. down to 110 deg. F. and then it had to be cleaned. Nalco treatmetn now eliminates cleaning and permits continuous operation at maximum temperature.

ANY WATER **NALCO SYSTEM** ANY PRESSURE

Inquiries other than domestic, *except those from U. S. Possessions. Canada and Mexico,* should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, Eng. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

advantage of being able to take over the duty of the electric heater a few moments after the burners are lighted.

Chicago, Ill. C A ARMSTRONG

Rubber Mountings Cut Elevator Noises

ELEVATOR noise may be troublesome and costly in hotels and office buildings. For example, tenants of a top-floor apartment next to the elevator hoistway were constantly leaving because of the noise, which made necessary frequent redecorating and the space could only be rented at a reduced rate. One proposal was to install a new elevator at a cost of $3600, but a more economical solution was found by placing the entire elevator mechanism on adequate rubber mountings, as in the photograph.

The mountings under the machine support the weight of the machine base, motor, gear unit, brake, cables, counter-weights, car and passengers. Each mounting supports a weight of about 750 lb. Four safety mountings of lighter construction support the contactor panel. Noise within the machine room is practically unchanged, but it is no longer telegraphed through the concrete structure of the building. Consequently, the elevator is silent insofar as the apartment is concerned. The rubber-mounting installation was made easily and quickly and at a fraction of the cost of a new elevator.

Detroit, Mich. WALTER C KEYS
United States Rubber Co

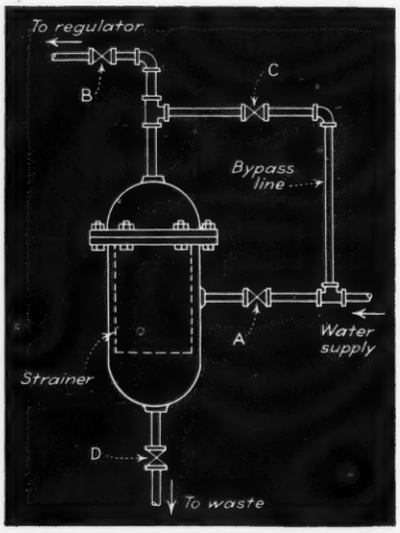
Excessive Hot-Water Temperature Dangerous

CLOSE temperature regulation of building and plant hot-water services cannot be over-emphasized. When temperature is too low, users become dissatisfied and there is a large waste of heat and water caused by leaving faucets running in the hope that the water will eventually run warm enough to be satisfactory. When water temperature is too high, heat is wasted, leakage occurs and maintenance costs go up because of rapid deterioration of faucet washers. Interior finish of the building is often jeopardized by escaping vapor and, what is most serious, safety of building occupants or plant personnel is imperiled.

Assuming that hot-water supply is properly designed and has sufficient capacity, maintenance of correct water temperatures is purely an operating and maintenance problem. Where automatic temperature control is used, which is indispensable if temperatures are to be held within close limits, operation is simple. Maintenance includes keeping heating surfaces clean, condensate drains open, and giving attention to the temperature control to be sure it will function satisfactorily without sticking.

Failure to observe these simple precautions will result in dissatisfaction and may have serious consequences. Recently there came to my attention the case of a man fatally scalded in a shower bath. This was found to be directly caused by an open valve in a bypass line around an automatic temperature controller. The valve was opened by someone when the controller was in need of maintenance and had been forgotten. In spite of frequent complaints about excessive water temperatures, nothing had been done to restore the controller to service until too late to prevent the fatality.

Roanoke, Va. S H COLEMAN

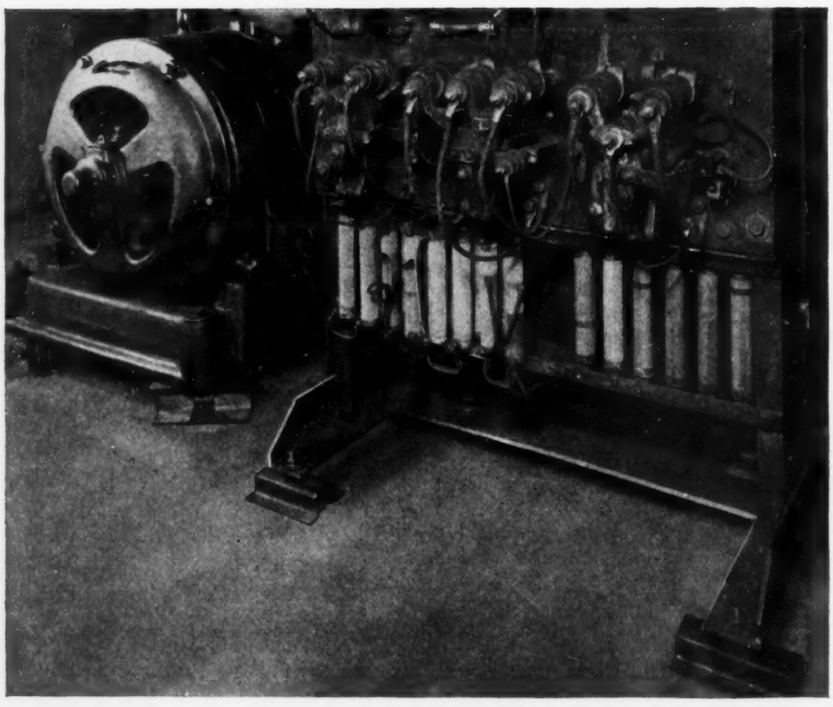


Bypass Simplifies Strainer Cleaner

STOKER SPEED, forced and induced draft are automatically controlled on our small boiler by cables and rods simultaneously actuated by a single regulator sensitive to variations in header steam pressure. This regulator has a pilot controlled double-acting power cylinder using city-water pressure as an operating medium. Although the system as a whole has given entirely satisfactory service and is well suited for our operating conditions, some difficulty was experienced, immediately after its installation, in keeping the strainer in the pilot-valve water-supply line clean.

This chore frequently required complete dismantling of the strainer assembly. Installation of a bypass line around the strainer, as in the diagram, for reversing flow of water through the screen, has reduced regulator outage time and strainer cleaning costs almost to the vanishing point. Now, when the strainer becomes fouled, the regulator is removed from service for a minute or two, valves *A* and *B* are closed and *C* and *D* opened. When the screen has been thoroughly flushed the valves are restored to their normal position and the regulator placed back in operation.

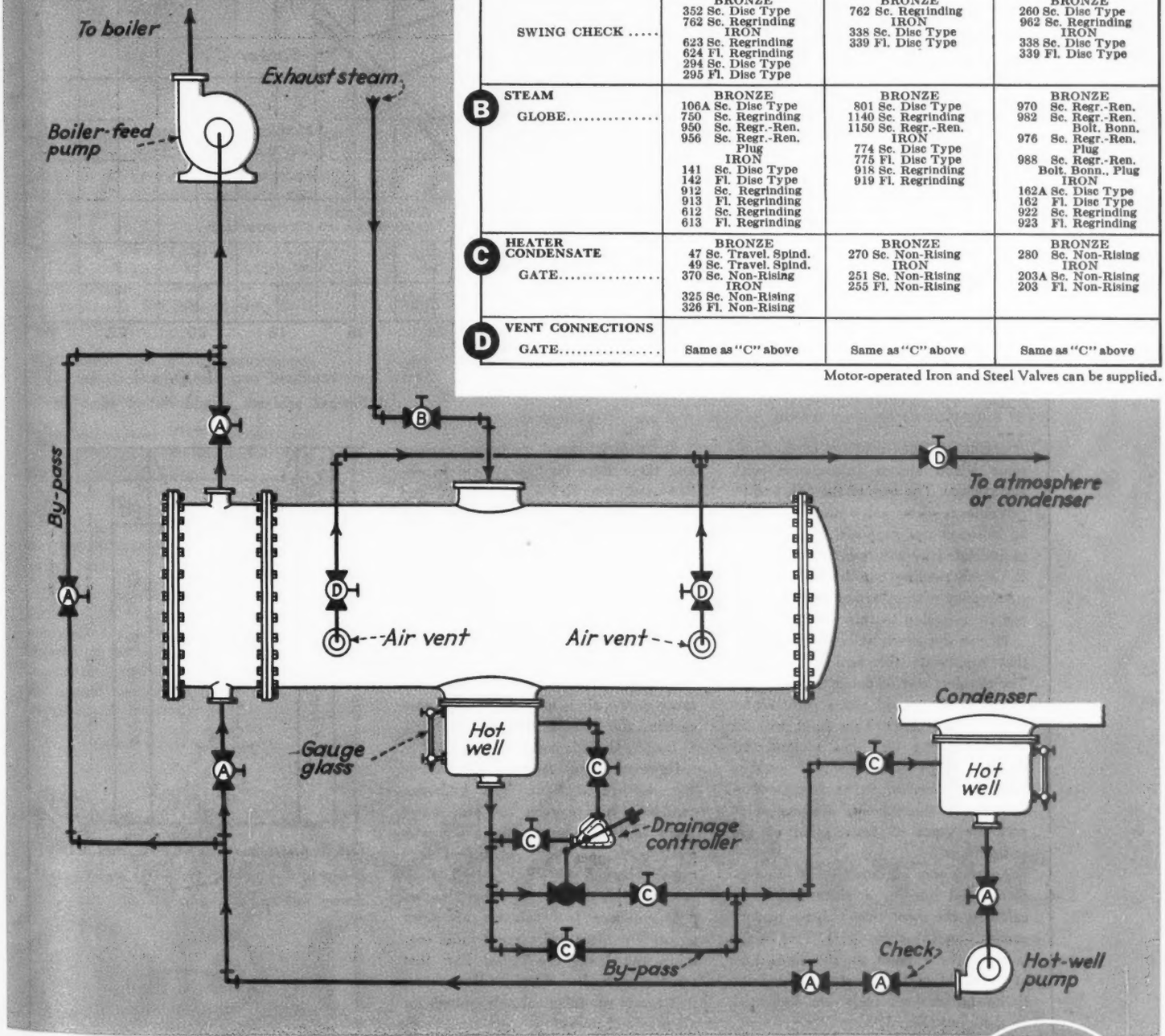
Richmond, Va. C R ANDERSON



. . . TO *GOOD* VALVE PRACTICE

Jenkins RECOMMENDS . . .

WATER, STEAM CONDENSATE AND VENT CONNECTIONS



REFERENCE CHART FOR JENKINS FIGURE NUMBERS

While Closed Heater Connections, Condensate Vent, etc. are usual in the lower pressures, we have listed valves to include Extra Heavy.

	Standard	Medium	Extra Heavy
A FEED WATER GATE.....	BRONZE 47 Sc. Travel. Spind. 49 Sc. Travel. Spind. 370 Sc. Non-Rising IRON 325 Sc. Non-Rising 326 Fl. Non-Rising	BRONZE 270 Sc. Non-Rising IRON 251 Sc. Non-Rising 255 Fl. Non-Rising	BRONZE 280 Sc. Non-Rising IRON 203A Sc. Non-Rising 203 Fl. Non-Rising
SWING CHECK	BRONZE 352 Sc. Disc Type 762 Sc. Regrinding IRON 623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type	BRONZE 762 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type	BRONZE 260 Sc. Disc Type 962 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type
B STEAM GLOBE.....	BRONZE 106A Sc. Disc Type 750 Sc. Regrinding 950 Sc. Regr.-Ren. 956 Sc. Regr.-Ren. Plug IRON 141 Sc. Disc Type 142 Fl. Disc Type 912 Sc. Regrinding 913 Fl. Regrinding 612 Sc. Regrinding 613 Fl. Regrinding	BRONZE 801 Sc. Disc Type 1140 Sc. Regrinding 1150 Sc. Regr.-Ren. IRON 774 Sc. Disc Type 775 Fl. Disc Type 918 Sc. Regrinding 919 Fl. Regrinding	BRONZE 970 Sc. Regr.-Ren. 982 Sc. Regr.-Ren. Bolt. Bonn. 976 Sc. Regr.-Ren. Plug 988 Sc. Regr.-Ren. Bolt. Bonn., Plug IRON 162A Sc. Disc Type 162 Fl. Disc Type 922 Sc. Regrinding 923 Fl. Regrinding
C HEATER CONDENSATE GATE.....	BRONZE 47 Sc. Travel. Spind. 49 Sc. Travel. Spind. 370 Sc. Non-Rising IRON 325 Sc. Non-Rising 326 Fl. Non-Rising	BRONZE 270 Sc. Non-Rising IRON 251 Sc. Non-Rising 255 Fl. Non-Rising	BRONZE 280 Sc. Non-Rising IRON 203A Sc. Non-Rising 203 Fl. Non-Rising
D VENT CONNECTIONS GATE.....	Same as "C" above	Same as "C" above	Same as "C" above

Motor-operated Iron and Steel Valves can be supplied.

JENKINS BROS., 80 WHITE STREET, NEW YORK, N. Y.

Bridgeport • Boston • Chicago • Philadelphia • Atlanta • Houston

1864—1939 DIAMOND ANNIVERSARY

#5 OF A SERIES designed to help in your selection of JENKINS VALVES

Number 82

Orsat Check Chart

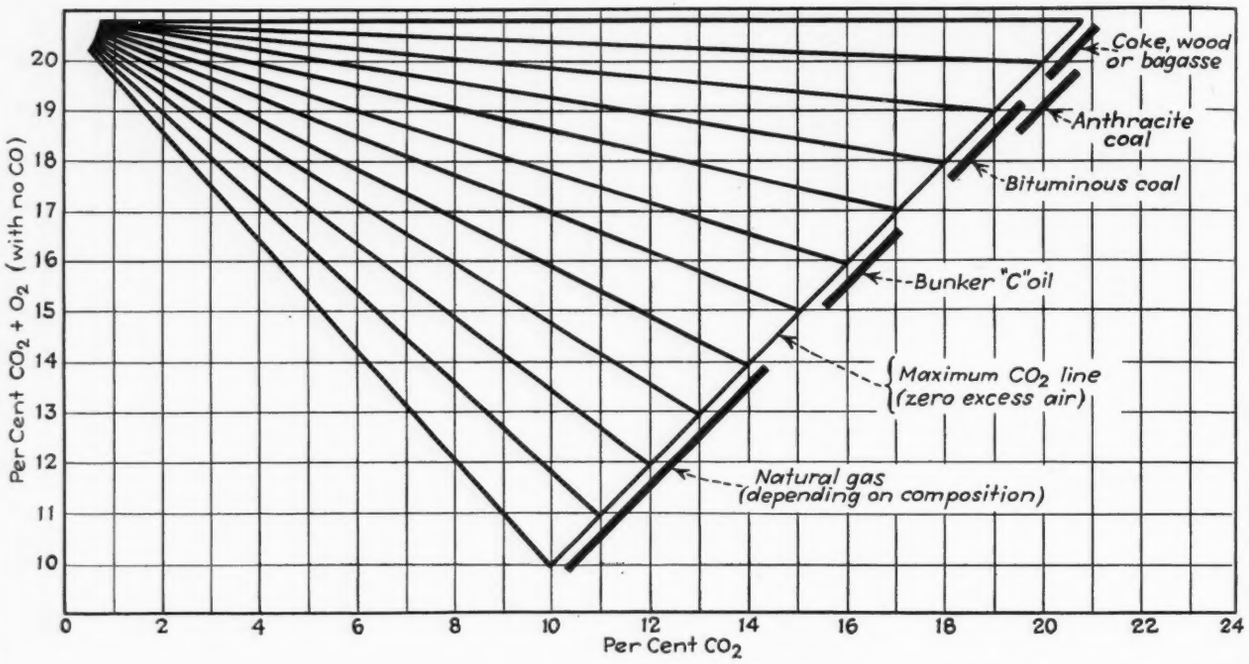

Per Cent $CO_2 + O_2$ (with no CO)
Per Cent CO_2
Coke, wood or bagasse
Anthracite coal
Bituminous coal
Bunker "C" oil
Maximum CO_2 line (zero excess air)
Natural gas (depending on composition)

Fig. 1—Radial lines represent sum of CO_2 and O_2 for any given fuel. All flue-gas analyses should lie on same line

A SERIES of Orsat readings often shows some which appear inconsistent with the average. The sum of the CO_2 and O_2 percentages does not remain constant, as is sometimes supposed, but changes as indicated by the radial lines in Fig. 1. Each reading can be checked for consistency with others or with an average by referring to this chart.

To use the chart, select a radial line that represents the fuel being used. The simplest way of doing this is to run several readings and plot a point representing an average. This point will lie on or between the lines plotted. All other readings should then lie on that line or, of course, on an intermediate line drawn through the average point and the point of intersection of the radial lines.

Another way of establishing the correct radial line for a given fuel is to calculate the theoretical CO_2 for perfect combustion (no excess air). This calculation gives a point on the limit line at the right of the chart. Approximate limits for various fuels are indicated on the chart, Fig. 1.

If the fuel burned were pure carbon, and there were no CO present in the flue gas, the 20.9% of oxygen and 79.1% of nitrogen (by volume) in air would show up in the flue gas as 20.9% of CO_2 and 79.1% of nitrogen, see Fig. 2. Whatever oxygen is converted into CO_2 would occupy the same volume as the original oxygen if cooled to original temperature.

This condition corresponds to the topmost line of Fig. 1. No matter how much excess air is used in burning pure carbon, the CO_2 and O_2 total 20.9% as long as there is no CO.

However, usual fuels contain hydrogen as hydrocarbons. The hydrogen combines with oxygen to form water vapor which condenses out in the sampling bottles and does not appear as a constitutent of the gas analyzed. Each volume of oxygen used to burn hydrogen produces two volumes of water vapor. The more hydrogen the fuel contains, the lower the radial line that represents the fuel. Straight lines represent actual conditions closely enough for all practical purposes.

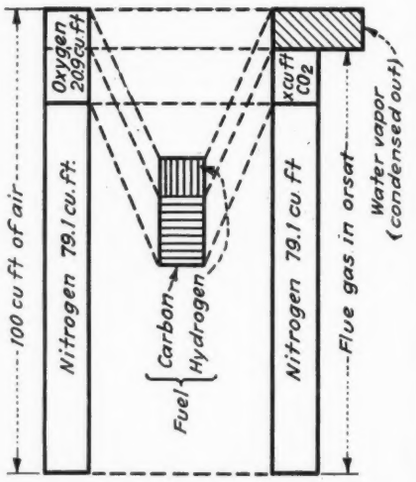
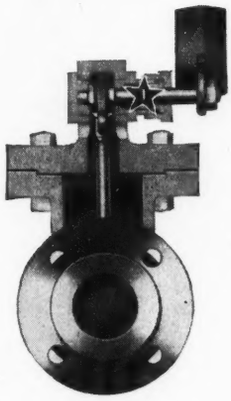


Fig. 2—Orsat analyzes only volumes of dry products of combustion; water vapor condenses out and is not measured

By Charles C Phelps

© POWER

The COPES "5-STAR" BALANCED VALVE



★1 The horizontal rotating lever shaft reduces friction to less than 2 pounds in the largest sizes, compared with from 6 to 16 pounds or more with a sliding stem.

★2 High valve lift, from ⅝-inch on ¾-inch valves to 1⅜ inches on 6-inch, permits more accurate control and increases the life of the inner valve parts.

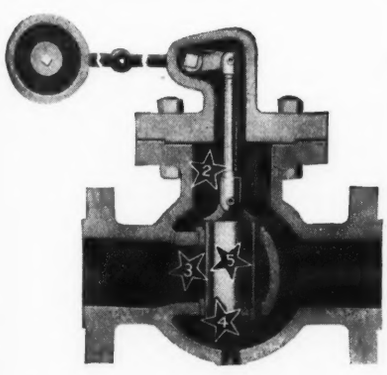
★3 Sleeve type or bevel-seating piston furnished as required by the operating conditions.

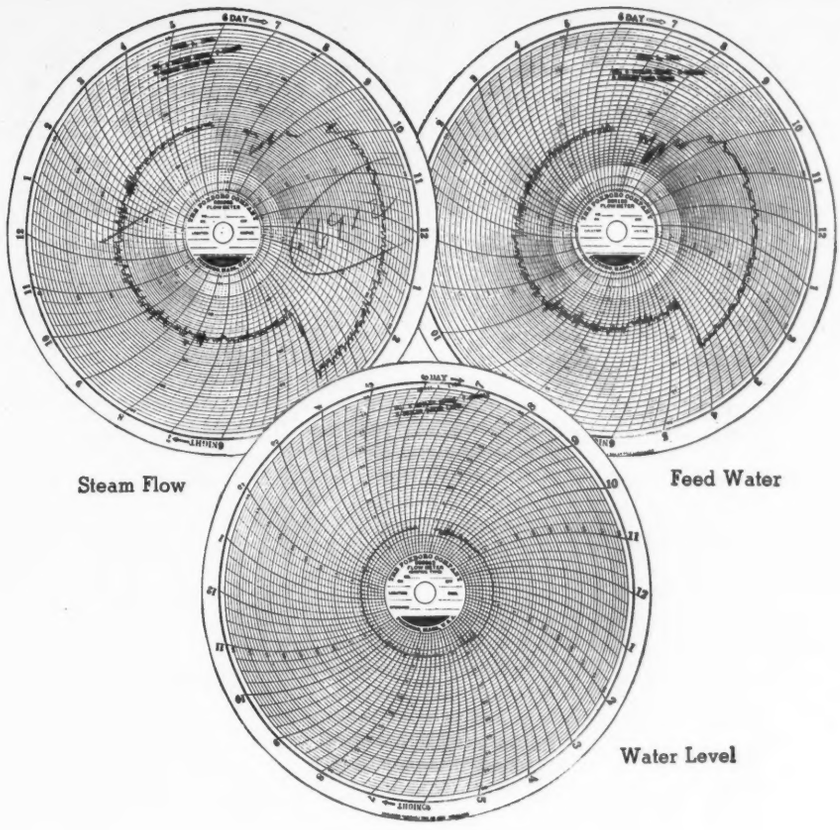
★4 Rectangular, "V" or compound ports are accurately designed for the operating conditions.

★5 Valve piston is scientifically balanced under flows and pressures, more so than any other make of "balanced" valve.

This "5-Star" Balanced Valve can be furnished for use with any actuating element. Or complete with solenoid, thrustor or motor for remote electrical control. Or with diaphragm operator for remote control by gas or air. For complete information—

Write for Control Catalog





A Large Refinery Reports

These charts show remarkably close boiler water level control—with accurate feed water regulation—outdoors on a 600-pound pressure Riley Generator. The Flowmatic Regulator was cut into service, adjusted and operated by the men on the job without "expert" supervision. If your loads vary widely, or swing rapidly, make sure of close water level control with the modern trouble-free COPES Flowmatic Regulator. Write for Bulletin 409-B.

NORTHERN EQUIPMENT CO., 511 GROVE DRIVE, ERIE, PENNA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY, AUSTRIA AND ITALY . . . . REPRESENTATIVES EVERYWHERE

Get closer level control with the

COPES

FEEDS BOILER ACCORDING TO STEAM FLOW•AUTOMATICALLY

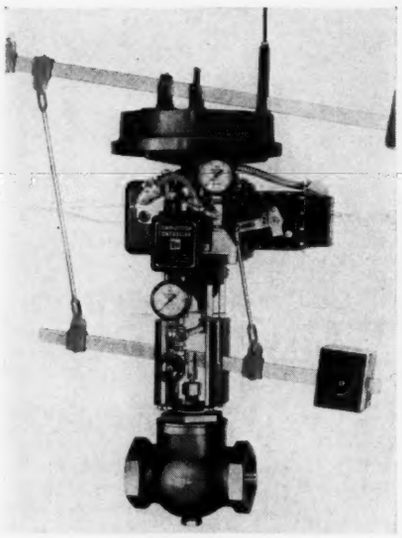
FLOWMATIC

★ REGULATOR

What's New in Plant Equipment

Combustion Regulator

TYPE V080A combustion regulator designed to hold steam pressure in gas-fired boiler within close limits, and control air supply to burner. Can be installed to fire automatically any radiant or blue-flame burner of the atmospheric type. Entire



control mounted on gas-valve bonnet at single point. A ¼-in. steam supply, exhaust line and connection to electric service completes installation.

Minneapolis-Honeywell Regulator Co, Minneapolis, Minn.

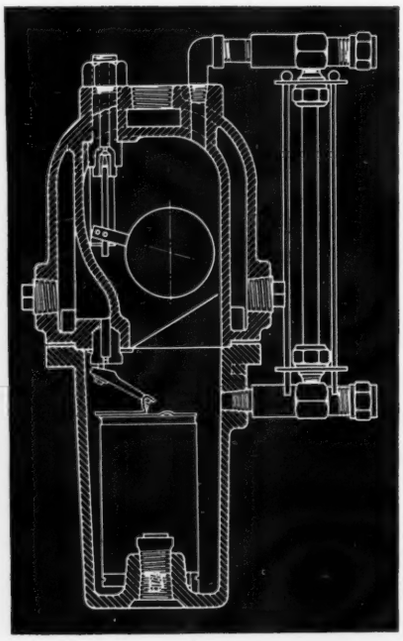
Universal Drafting Machine

MODEL 77 drafting machine has arm completely enclosing bands and working parts, to minimize accumulation of dirt between band and wheels. Additional improvement in form of full-vision protractor, located entirely above arm, gives unrestricted vision and greater operating convenience. Secondary 360-deg protractor movement also added, for setting protractor at any angle on drawing. Movement operated by thumbscrews. Exceptional accuracy is claimed by manufacturers.

Universal Drafting Machine Co, Cleveland, Ohio.

Refrigerant Gas Purger

UNIT removes air and incondensable gases from refrigerating systems using any common refrigerant except CO_2. Consists of inverted bucket and valve mechanism in lower half and ball float and needle valve in upper jacketed dome. It is connected to the high-side receiver so it can take gas from the top of the receiver and just enough liquid from bottom of receiver to keep the cooling jacket filled. When used

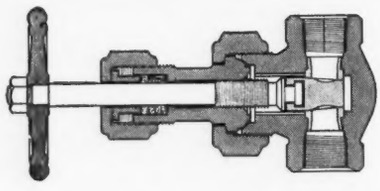


as combination purger and expansion valve, unit is connected to bottom of condenser, taking liquid refrigerant as fast as it forms and discharging to the low-side evaporator. Flow brings any air present into the purger, where it is collected and discharged from the upper chamber.

Armstrong Machine Works, Three Rivers, Mich.

Gate Meter Valves

DROP-FORGED steel-gate meter valves are union bonnet, ground joint, inside screw-stem type with removable rolled-in seats and loose, slotted gate. Made in sizes of ¼-, ⅜-, ½-, ¾- and 1-in., of carbon steel

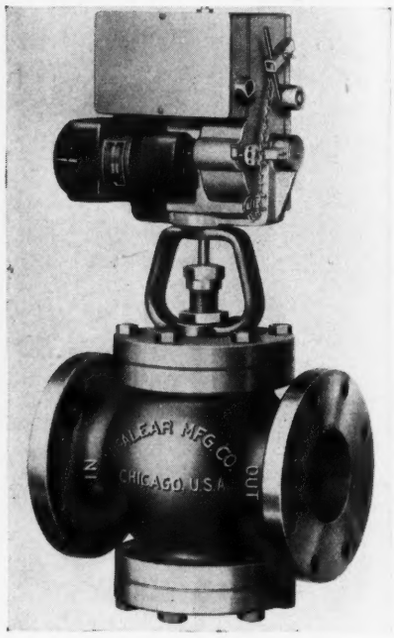


with stainless steel trim or all-stainless steel. Suitable where regulation is required for meter and gage lines at high pressures and temperatures.

Henry Vogt Machine Co, Louisville, Ky.

Electrically Operated Valve

No. 1100 electrically operated valve, with safety-torque-limit device, prevents damage to power unit should obstructions lodge in valve and prevent it from seating. Also provided with means of manual operation in case of power failure. Suitable for any purpose where remote-control valve is needed, either on acids, alkalis or high temperatures where the corrosive effect is not too great. Unit may also be equipped with necessary contact-making device to signal back to operator position of valve. Units will operate in any position and are supplied for 110 volts, ac or dc, with brush-type motor. Gear train enclosed



and packed in grease and all gears are machine-cut steel. Furnished in all sizes up to 6-in. both single and double seated, flanged or screwed, in any of the usual ferrous or non-ferrous bodies and trim. Bulletin M-5.

The McAlear Mfg Co, 1901-09 So. Western Blvd, Chicago, Ill.

Continuous Blowdown Valve

"ANUM-METL" seats and disks feature this continuous blowdown valve designed for severe conditions. Seats have been made hard without sacrificing toughness. Tests are said to have shown that its taper, throttling-type seats and disks, and metering dial permit easy and accurate control of blowdown.

Strong, Carlisle & Hammond Co, Cleveland, Ohio.

Idler Pulley

BALL- and roller-bearing pulley consists of balanced standard or special pulley (1) provided with dust-proof cover (2), which eliminates all types of abrasive dust from heavy-duty bearing (3) and stabilizing ball bearing (4). Bearings run directly on hardened chrome-steel shaft (5). Grease cup (6) provides for measured amount of grease every second year of operation, and large reservoir (7) is filled at factory

LESS COST, LESS SPACE MORE GALLONS!

Three BIG Reasons Hundreds of Plants are Switching to Allis-Chalmers Extra-Value SSUnit Pumps!

The little pump with the big money-saving performance . . . that's what men in the field say about the sensational SSUnit Pump! And here are the three big reasons they're switching to this low-cost motor-coupled pump . . . originated by the same Allis-Chalmers engineers who designed and built the gigantic turbines at Boulder Dam and Niagara Falls.

LESS COST! Simple design cuts first cost to a new low! Enclosed runner, wearing rings, and shaft sleeves are made of bronze — no chance for rust or excessive wear that runs up maintenance costs! SSUnit Pumps are completely tested before delivery . . . no wasted time or effort . . . they go to work for you the minute they're installed!

LESS SPACE! They set new records for compactness . . . these husky SSUnit Pumps! And they'll operate vertically or practically any way you want them to. That means you can save valuable space in your plant!

MORE GALLONS! You get more gallons with SSUnit Pumps because you get more efficient operation. Actual results in the field prove that new SSUnit Pumps in many cases give more than a 15% greater supply of water than older types of pumps . . . and that more water means more power dollars saved!

But you don't stop there! For coupled to the SSUnit pump is the famous Allis-Chalmers Lo-Maintenance Motor . . . the motor that has proven performance records of beating conditions that many times wreck ordinary motors in a few weeks. There's no "buck-passing" . . . Allis-Chalmers accepts full responsibility for both motor and pump!

PUMPING BRINE IN REFRIGerating system of a large county institution, this SSUnit Pump takes less space, costs less, gives more gallons!

Call the nearest district office today . . . or write direct to Allis-Chalmers. That's the way to get started on real pump savings!

1064

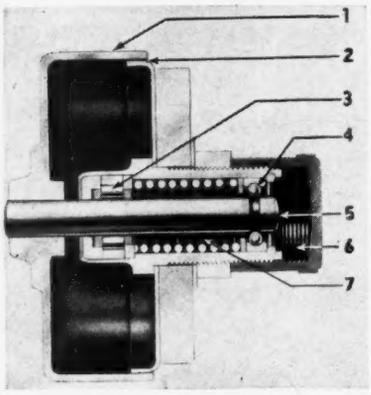
CENTRIFUGAL PUMP DIVISION

ALLIS-CHALMERS

MILWAUKEE·WISCONSIN

90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

to last first 2 years. Five standard sizes available: 2¾x3½ in., 2¾x1¼ in., 3½x1¼ in., 3½x1$\frac{11}{16}$ in., 4¾x1¾ in., with over-all lengths up to 3$\frac{15}{16}$ in. Units provided for special designs have same over-all length and pulley diameters can be



reasonable size that can be mounted on axles of 0.3071 in., and 0.3465 in., in diameter.

S K F Industries, Inc, Philadelphia, Pa.

Drafting Cloth

"PENCIL-TEX" pencil drafting cloth is claimed to produce sharp, uniform, ink-dense line with hard pencils. This line intensification, together with a glass-like transparency, permits reproduction of a blueprint with the sharp contrast of "prints" made from fine ink tracings. Prints made through this product are said to be completely without fuzzy lines and fogginess.

Frederick Post Co, P O Box 803 Chicago, Ill.

Pyrometer Controller

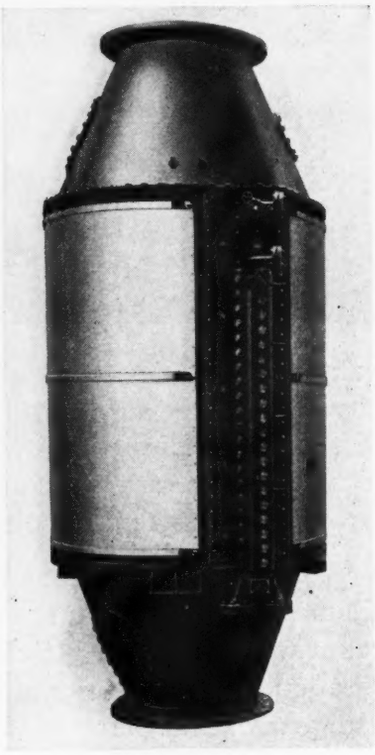
"CELECTRAY", Model V, indicating potentiometer has damped photoelectric circuit which does not respond to abnormal disturbance of light beam. Controller can be mounted rigidly in vibrating panel together with contactor without regard for

possible vibration. Instrument sensitive to temperature change but not to vibration. All features of previous models retained, such as safety shut-off, 15-in. scale, 0.1% accuracy and indications by brilliant white, red or green line of light on ground glass.

C J Tagliabue Mfg Co, Brooklyn, N. Y.

Waste-Heat Steam Generator

In "La Mont" forced-circulation waste-heat boilers, pump supplies seven to eight times, by weight, as much water to each tube as is converted into steam, and coils of small tubing are arranged in parallel between an inlet and an outlet header. A nozzle at the entrance to each tube insures adequate flow in the parallel circuits. In the unit illustrated, for utilizing heat in diesel exhaust, tubes are spirally coiled, but arrangement of heating surface and the location of drum are flexible and can be adapted to any space conditions. Where



an auxiliary boiler already exists, it may be used as a receiver for the La Mont unit and thus eliminate the necessity of a separate drum. The design involves a minimum number of joints.

While such applications to diesels usually employ exhaust-gas temperatures of 500 to 800 F with steam generated at 50 to 180 lb per sq in., the boiler is also applicable to very much higher-gas temperatures and steam pressures in stationary waste-heat installations. Of the 700 La Mont steam-generating units now in service abroad, a representative number are of the waste-heat type.

Combustion Engineering Co, Inc, 200 Madison Ave, New York, N. Y.

Pressure Fan

"AXIFLO" pressure fan constructed to operate against wind or resistance of filters, baffles, discharge conduits, etc. Blades pitched so that air delivery is not impaired, according to manufacturer, regardless of fan location or velocity of opposing wind. Has mechanical efficiency of 79% and ability to overcome system resistance up to 1½-in. w.g., and is available for direct-connected motor drive, illustrated, or for

belt drive. Arranged for wall, floor, platform, or ceiling installations. Eleven sizes available, ranging from 18-in. to 60-in. diameter, with capacities up to 75,000 cu ft per min. Catalog 444.

B F Sturtevant Co, Hyde Park, Mass.

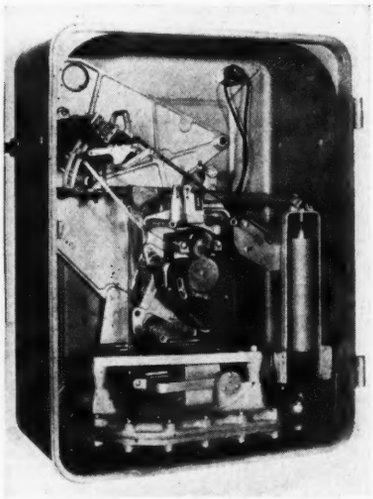
Belt Cutter

"UNIVERSAL" Belt Cutter handles leather, fabric, and rubber belts up to 8-in. width. Holds belt securely against side guide, while special knife is drawn down track to assure even cut. May be carried to job or may be bolted to bench. Blade can be sharpened or replaced.

Armstrong-Bray Co, Chicago, Ill.

Air-Flow Meter

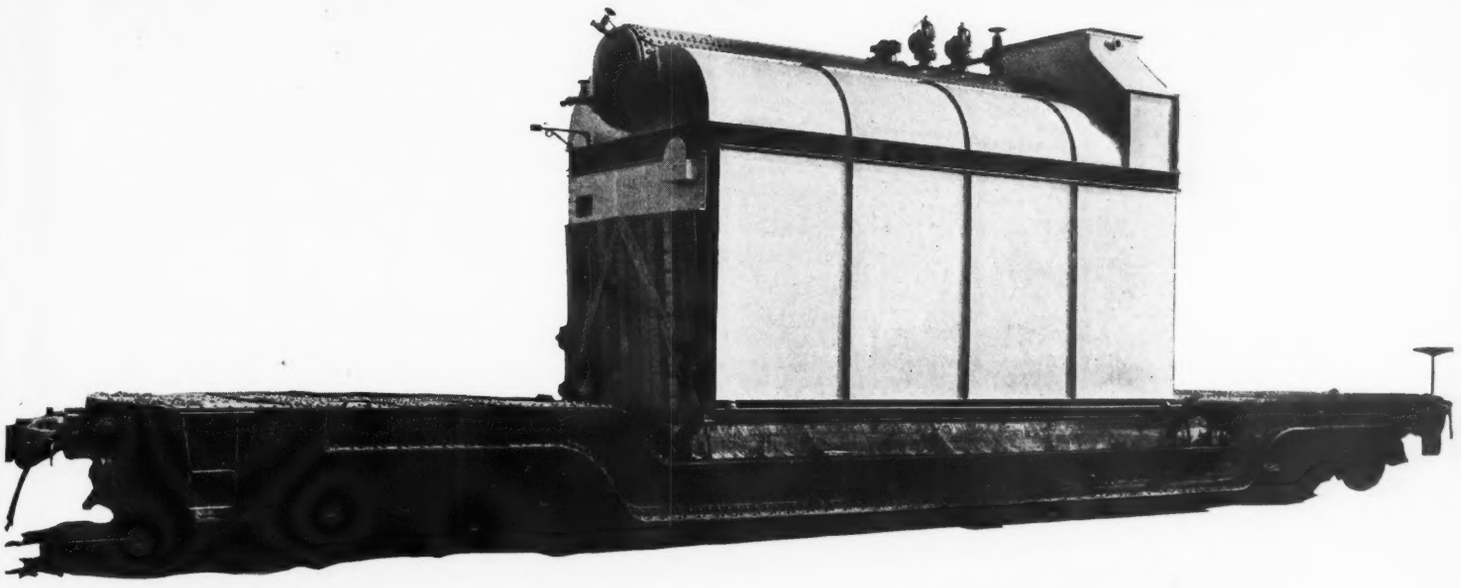
DIAPHRAGM-OPERATED air-flow mechanism, for use with standard Bailey steam-flow, air-flow boiler meter, is said to simplify



application of meters to steam-generating units where high static draft conditions are encountered. With it, air-flow connections can be made in economizers, air heaters, or boilers, where high draft pre-

KEELER

TYPE CP STEAM GENERATOR



A PACKAGE OF POWER

Another feature that engineers admire in the type CP Generator is its *completeness.* Installation is quick, easy and inexpensive compared to the setting up of conventional boilers . . . Add that point to these 12 advantages and see if the CP doesn't approximate your idea of "a package of power" . . . (1) Completely steel cased and insulated . . . (2) Has water cooled side walls . . . (3) Costly furnace repairs eliminated . . . (4) Has built in soot blower . . . (5) Unrestricted circulation . . . (6) Steady water level . . . (7) Dry steam at all ratings . . . (8) Requires less head room . . . (9) Requires less floor space . . . (10) Longer gas travel, higher efficiency . . . (11) More steam space and water storage . . . (12) Capacities to 50,000 lbs., pressures to 450 lbs . . . All of these advantages cannot be found in any other Steam Generator of similar design. The Keeler Type CP is the original of its type. The coupon below will bring you complete data . . . Mail it today.

The fact that this concern has been in business three-quarters of a century may not interest you personally. But to carry on for that many years it must follow that a great many people have liked to do business with us. We believe your first transaction here will show you why.

E. KEELER COMPANY

Builders of betters boilers . . . WILLIAMSPORT, PA.

Please send complete data on the CP Steam Generator to:

Name ..... **Title** .....

Firm .....

Address .....

cludes use of usual oil-sealed mechanism. Coated silk-diaphragm is clamped between flanges of metal housing. Air-flow connections made to housing on each side of diaphragm so that changes in differential pressures are measured and recorded in terms of air flow.

Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland, Ohio.

Solenoid Valve

TYPE H has lower section of coil housing empty which provides terminal chamber into which the wires are pushed after making electrical connections. Adaptor receives straight or angle BX connector or conduit lock-nut. For cord connections

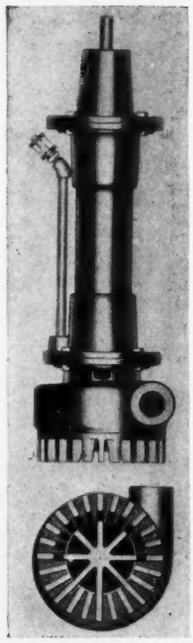
porcelain bushing is inserted in adaptor. Valves will control water, air, gas, steam, or oil, and pipe sizes are ⅛-in., ¼-in., or ⅜-in., with 5/32-in., and 1/16-in. diameter orifice. Composition tip in impulse plunger and similar stop at the upper end of the plunger travel said to silence usual click when valve opens or closes. Leaflet 4110.

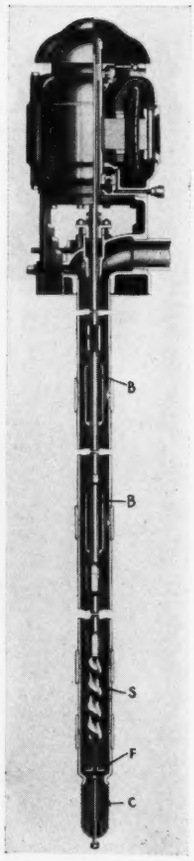
Supreme Electric Products Corp, Rochester, N. Y.

Diesel-Engine Lubricating Oil

"RPM DELO" lubricating oil is designed for all diesels regardless of size or design. Tests point out that oil is non-corrosive to alloy bearings, reduces wear of cylinders, pistons and rings, and prevents ring-sticking even under most severe operating conditions. Compounding material in oil is said to be resistant to oxidation and deterioration and stable in presence of moisture and in storage.

Standard Oil Co of Calif., San Francisco, Calif.





Lubricant Pumps *(above)*

MODELS FV, FB-V and F-VB lubricant pumps are used in conjunction with machine tools or auxiliary tanks. Model FV and FB-V can be attached to side of tank and submerged into tank. F-VB mounts on coolant tank or machine pedestal for close coupled installation. Units are built in capacities up to 175 gpm and pressures up to 53 lb sq in.

Pioneer Engrg & Mfg Co, 31 Melbourne Ave, Detroit, Mich.

Deepwell Pump *(above right)*

"HI-LIFT" of deepwell pump comprises stator, *s*, made of a cutless-rubber cylinder having on its inner rim a helix with twice the number of threads as rotor, which is of hard chrome heat-treated stainless steel. The interaction of these two elements as rotor revolves squeezes the liquid ahead with positive-displacement action. Since one element is cutless rubber and other hard stainless steel, combination is highly resistant to abrasion. Shafting connecting the pump and driving motor has hard chrome-stainless-steel surfaces in cutless-rubber bearings supported in pipe column. One-piece bronze strainer *c* with a rubber seated foot valve *e* below pump keeps column full of water and no prelubrication is necessary. Available for wells 3 in. in diameter and larger and for heads from 40 to 1000 ft deep. Capacities begin at 5 gpm.

Peerless Pump Division, 301 West Ave, Los Angeles, Calif.

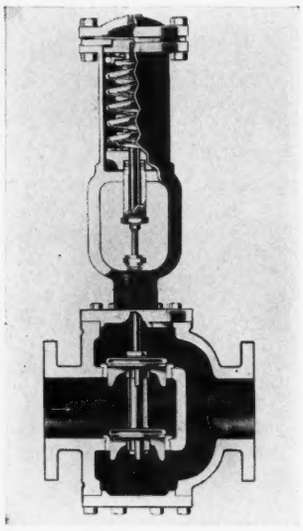
Castable Refractories

"FIRECRETE", for making special refractory shapes, and other similar applications, is suitable for working temperatures up to 2200 F. Has low heat-storage capacity, and said to be four times as effective as brick in retarding heat, while having only half its weight. 65 lb required per cu ft of finished construction, and 24 hr after casting, is ready for service.

Johns-Manville Co, 22 E 40th St, New York, N. Y.

High-Pressure Governor

TYPE 516 is for high-discharge pressures on oil or other liquids, and installation on piston actuated governors, where discharge pressure is too high for standard diaphragm assemblies. Governor is spring actuated and has extra-heavy diaphragm assembly and nested spring. Reversible body with large valve ports and inner valve



is said not to be affected by fluctuating steam pressures. Sizes range from 1- to 3-in. with screwed ends, and from 1- to 4-in. with standard flanged ends. Valve-body working pressures range from 125 lb at 450 F to 100 lb at 100 F. Catalog B.

Fisher Governor Co, Marshalltown, Iowa.

Insulation Tape

"TWINSULATION" tape, combination friction and rubber tape, said to be adaptable to all kinds of electrical work. Due to high dielectric strength, less tape applied will suffice where more tape was formerly necessary.

United States Rubber Co, 1790 Broadway, New York, N. Y.

Portable Compressor

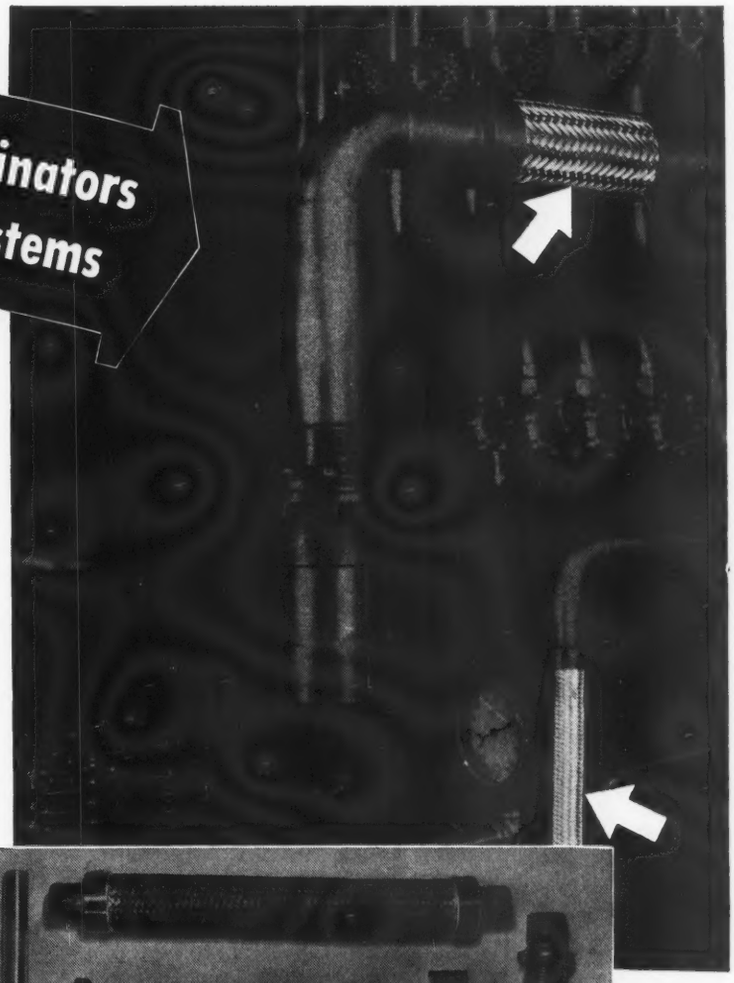
MODEL 210A is air-cooled, 2-stage machine, newer models having I-R channel valves which, it is claimed, make for more efficiency, cooler and quieter operation of machine. Available in five sizes for capacities of 85, 105, 160, 210, and 315 cfm of air at 100 lb. Powered by either Waukesha heavy-duty industrial gasoline engines, or I-R Type H oil engines. Ther-

(*Continued on page 136*)

Whenever you need a flexible connector for liquids or gases, use

American Seamless Flexible Metal Tubing

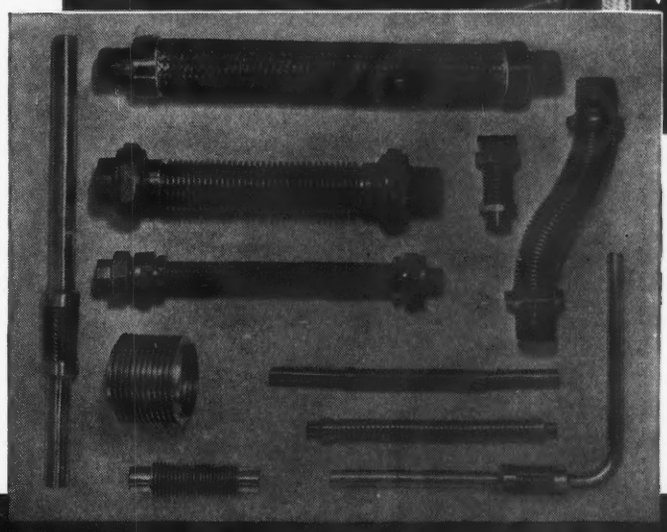
Example: Vibration Eliminators for air-conditioning systems



FOR permanent tightness in liquid or gas lines...for protection against breakage or leakage under constant flexing...for the elimination of excessive vibration, there's only one 100% correct answer to your problem. You need flexible tubing that's free of laps, seams, welds or joints of any kind. One that's made of strong, *seamless* metal tubes. And that means American Seamless Flexible Metal Tubing.

"American Seamless" is used regularly in thousands of applications for carrying steam, oil, air, liquids and gases for heating, cooling or lubricating machine parts that must move frequently; for absorbing vibration in rigid pipe lines; for quick and economical connection of misaligned parts.

When you have a flexible connector problem, put it up to our Engineering Department. Meanwhile, write for our new reference Catalog SS-25. 39237



RIGHT: *Just a few of the many hundreds of special flexible tubing assemblies that we have designed—each to perform a specific duty.*

American Metal Hose

ANACONDA from mine to consumer

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company

Pity the Poor Peddler . . .

MY FIFTEENTH summer, I was chief engineer (unlicensed) at a boys' camp. My biggest job was to be nursemaid to a hydraulic ram, keeping it chonking away so we got water 90 feet up the hill. When it stopped, a hundred kids went dry, and the cook couldn't cook.

Well, y'know, that ram was as temperamental as a live one. It used to stop night after night. I'd nurse that thing until midnight, then roll out of bed at dawn to start it again. I was one chief that had a 24-hour trick. Finally, I rigged up a bell that would ring whenever the ram stopped—and then the bell rang day and night until my tentmates threatened to throw me out.

One day a pump salesman stopped in to see the camp director, who sent him on to me. "Listen, Mister," says I, "You better get along about your business. Hear that bell? That means that valve leather has swelled and stuck the ram again! I gotta git down there and fix it."

Well, sir, that peddler came along down the hill, slipping and sliding in the mud. When I got the leather out, he said, "Here, Young Feller, try this one instead." I figured he was trying to high-pressure me, but I finally put it in. We went back up the hill, and I didn't go back down for a week, then only for a routine visit. Why? That peddler, among other things, was selling non-swelling cup leathers.

That taught me a lesson that maybe the salesman who comes to see me may have something worth looking into. So I see 'em, and about every fifth one has got an idea I can use. That's a pretty good average to me.

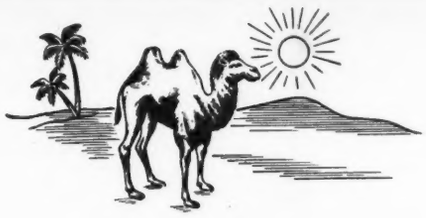
Some of my cronies never see a peddler because "they waste my time." But time-wasting, like a fight, takes two people. You can always get rid of 'em with a little practice. And if they're persistent, remember that the Lord must have had some reason for inventing a hammer.

Some of the rest of the boys say, "Our company isn't buying anything now," or "I see salesmen only from 3 to 4." I wonder what would happen if somebody came around to the first one with something that would pay for itself in six months. Would he stick to his guns? And as for the second, what happens to his own company's peddlers? Do they work only an hour a day?

It seems to me that the Golden Rule is a good one to remember here. "Do unto others as you would have them do unto you." It's at least as important for the man at the plant to exhibit "buymanship" as it is for the company's peddlers to show salesmanship. What's buymanship? Nothing but an intelligent, sensible approach toward buying—not a defensive, suspicious, hardboiled attitude that harms nobody but the buyer.

George Edwards

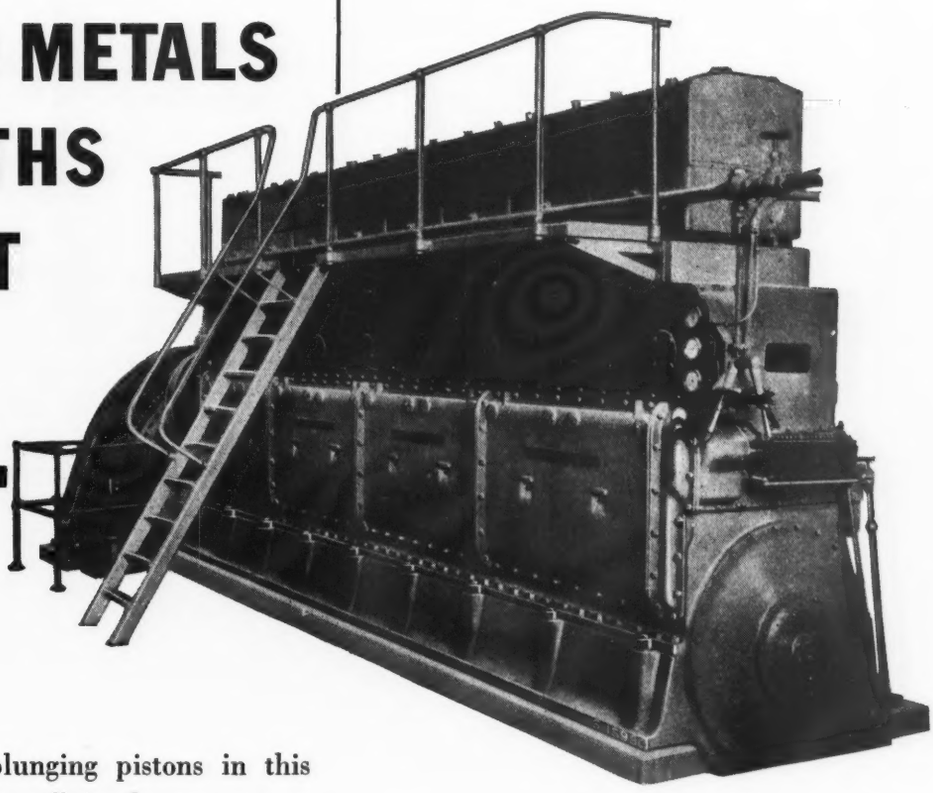
Engineer



A camel goes for days without water . . . but

MODERN METALS GO MONTHS WITHOUT REST!

Worthington EE-8, 1000 BHP industrial Diesel, built by the Worthington Pump & Machinery Corp., Buffalo. This 4-cycle 16" x 10" engine is rated at 327 RPM. It uses a circulating pressure lubricating system and direct injection. See the list below for Nickel cast steels, wrought Nickel steels, Nickel cast irons and Nickel bronzes used to safeguard this prime mover.



Month after month, eight plunging pistons in this Worthington Diesel smoothly, efficiently generate a thousand horse power. Long runs impose severe fatigue stresses on metals. Stresses which are absorbed by the extra toughness Nickel imparts to irons and steels.

Worthington uses Nickel to provide superior qualities in castings and forgings, permit heat treatments to develop maximum physical properties. Nickel alloyed materials uniformly resist growth under prolonged elevated temperatures, maintain close fit and pressure-tightness.

You are invited to write for a convenient check list of Diesel applications of Nickel alloy steels and Nickel cast irons.

WHERE WORTHINGTON USES NICKEL

Cast Nickel Steels:

Main bearing caps, camshaft gear clamp ring, lubricating oil deflector, camshaft gears, air starting lever, intake manifold elbows.

Wrought Nickel Steels:

Air inlet spring guides, air starting valves, delivery valve stems, fuel nozzle bodies.

Nickel Cast Irons:

Cylinder heads, cylinder liners, pistons, inlet valve casings, exhaust valve casings.

Nickel Bronze:

Bellows spindle guide.

NICKEL CAST IRONS ALLOY STEELS

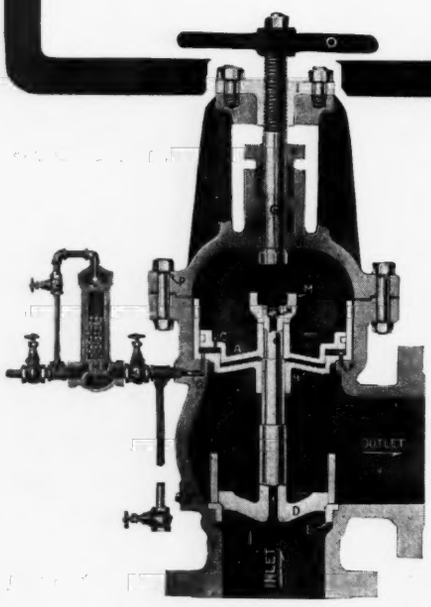
THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

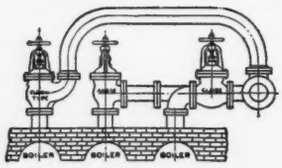
★

Golden-Anderson

SPECIALTY

VALVES





TRIPLE ACTING NON-RETURN

● No boiler plant is *safe* without them! Protect life and property against boiler explosion or bursting steam line. Double cushioned, will not stick or chatter. Can be tested any time, under pressure. The heaviest valves of this kind made . . . 2½" to 16" sizes in angle, globe or elbow types, with either flanged ends or welding necks . . . for 150 lb. to 1500 lb. service.

Ask for illustrated catalog

also

Altitude Control . . . Pressure Reducing . . . Throttle and Emergency Stop . . . Check . . . and other types of valves.

Golden-Anderson Valve Specialty Co.

Fulton Bldg. • • • Pittsburgh, Pa.

Engineers' Books

(Continued from page 104)

This revised edition continues the original conception of a single volume containing mathematical tables and design formulas for ready reference by engineers for application to design problems.

Fans

FAN ENGINEERING (4th Edition—1938). *Edited by Richard D Madison. Published by Buffalo Forge Co, Buffalo, N. Y. 740 pages, 4x6 in. Price $4.*

Of particular interest is new material on all branches of air conditioning, heating, cooling, ventilation, air motion, humidity, air cleaning and sound control. 120 pages added to earlier edition also contain a new section on fan details, performance of typical fans and selection of equipment. Indexed for quick reference.

Boilers

PAPE-SWIFT BOILER REFERENCE BOOK (6th Edition—1939). *By Oscar H Pape, compiler. Published by John S Swift Co, Inc, 230 W 17th St, New York, N. Y. 344 pages, 5½x8¼ in., tables and diagrams, paper binding. Price $1. Master Index for years 1934 to 1939, paper bound, price $.25.*

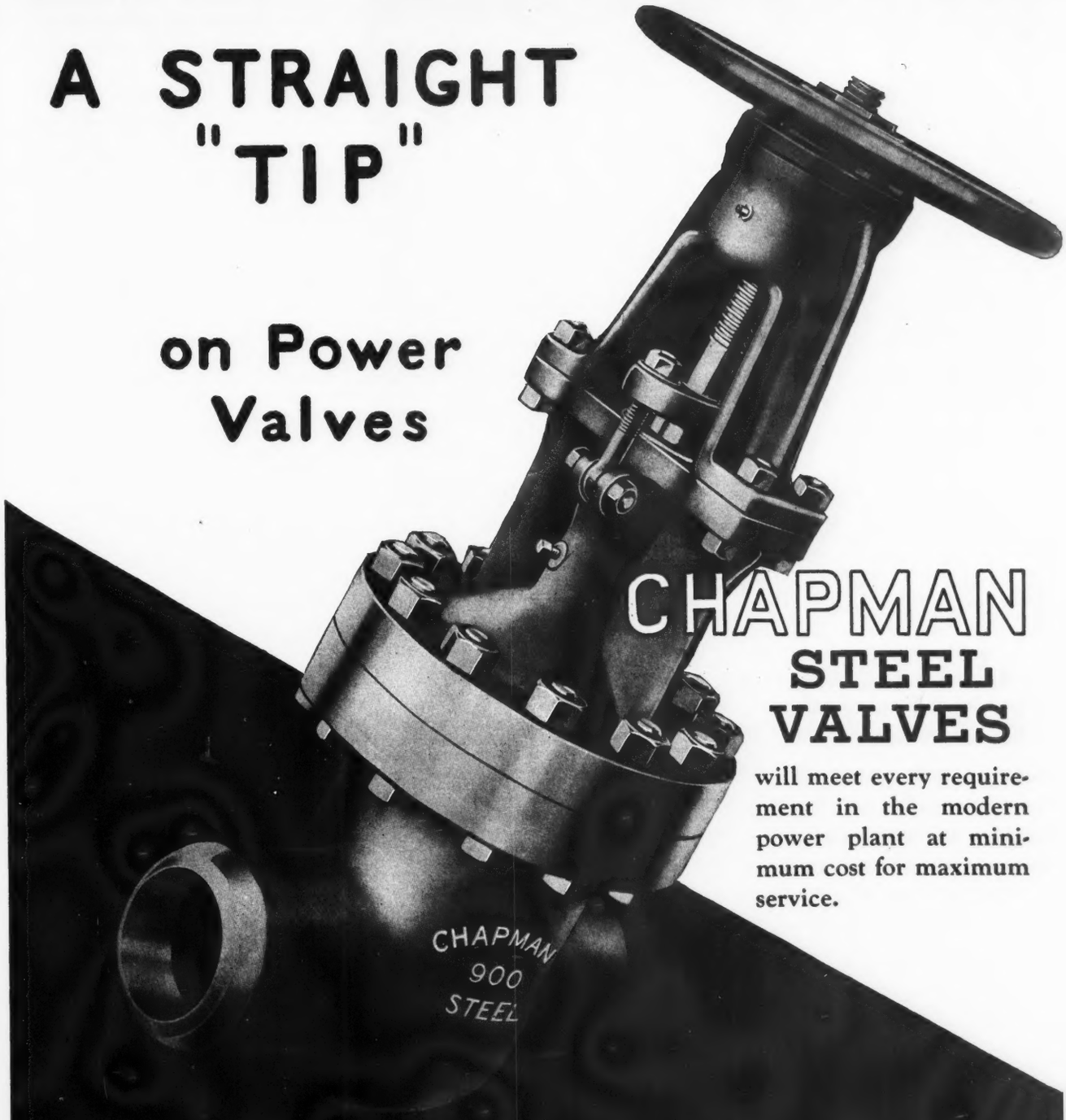
New edition contains information and data from various manufacturers not mentioned in former issues. Also has specifications and capacities of current, obsolete, and discontinued types of steam, hot-water and gas boilers, together with line drawings and illustrations, giving dimensions. Lists trade names, serial numbers and individual boiler numbers in each series. Index lists over 1000 models of boilers of more than 100 different manufacturers.

Brief Reviews

ENERGY RESOURCES AND A NATIONAL POLICY (1939). *Published by National Resources Committee, Washington, D. C.*—This report, prepared at request of President Roosevelt, outlines immediate steps on the part of the government toward the forming of a national energy resources policy, in the interests of national defense, conservation, and economic betterment. Report deals with coal, oil, natural gas, and water power. Specific suggestions and recommendations given in regard to promoting greater efficiency in production of the fuel resources, greater economy in use of fuels, and placing a larger share of energy burden on lower grade fuels and water power.

DIRECTORY OF ASSOCIATION MEMBERS (1939). *Published by the Association of Consulting Chemists and Chemical Engineers, Inc, 50 East 41st St, New York, N. Y.*—Booklet contains directory of members of Association, descriptions of each member's qualifications, scope, functions, and activities, and "Key Sheet" to enable clients to select proper consultants for individual needs.

A STRAIGHT "TIP" on Power Valves



CHAPMAN STEEL VALVES

will meet every requirement in the modern power plant at minimum cost for maximum service.

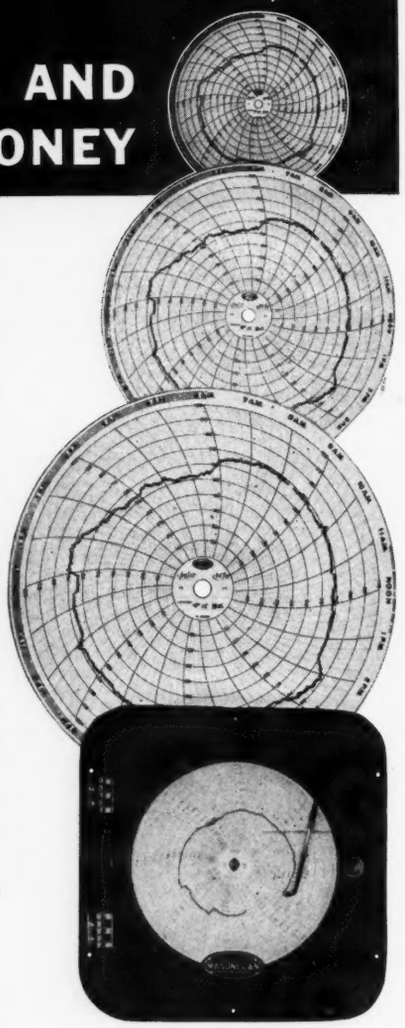
Chapman Steel Valves have been standardized to include all types and sizes in carbon steel or alloys best suited to meet specific service conditions. A sound investment is assured when Chapman Valves are specified, for standardization, based upon years of experience and research, means higher quality for your investment.

THE CHAPMAN VALVE MANUFACTURING COMPANY

INDIAN ORCHARD, MASS.

History

THAT MAKES AND SAVES YOU MONEY



MASONEILAN Recording Thermometers and Pressure Gauges write an accurate, unbiased history of industrial processes—providing the data which enables you to check cause and effect; forming permanent records for your future guidance. The advantages of knowing have been proved thousands of times by increased production, lower costs and consequent greater profits. The advantages of writing process records with Masoneilan Recorders are daily exemplified by the accuracy, response, simplicity and reliability of thousands giving excellent service in all types of industry. Their moderate cost is a small item when compared to the savings they make possible.

Get the facts—write for Bulletin No. 3010

MASONEILAN

REG. U. S. PAT. OFF.

1186 ADAMS STREET BOSTON, MASS., U. S. A.

New York · Tulsa · Buffalo · Chicago · Pittsburgh · St. Louis · Philadelphia · Houston · Los Angeles

MASONEILAN, 1186 ADAMS ST., BOSTON, MASS.

Please send me Bulletin No. 3010

Name_____

Title_____

Company_____

Address_____

Readers' Problems

(Continued from page 103)

too small, especially since forced circulation is used. It is also possible that supply piping will grade up away from the supply on horizontal runs. This would not be satisfactory as condensate would be trying to flow back against steam. It is probable that all or most supply piping would have to be replaced by larger piping. The return piping would probably have sufficient capacity. A pump and receiver might be required to return condensate to the boiler plant.

In other words, it is probable that it would cost quite a lot to convert the system; as a rough estimate it might be as much or more than $.50 per sq ft of required steam radiation.

Montreal, Canada S CAMPBELL

Convert to Orifice System

CHANGING a hot-water system to direct-steam should be reasonably simple and inexpensive. There is sure to be ample radiation for low-pressure operation at from 1 lb to a vacuum of 2-5 in. It is a perfect setup for use of orifices at radiator inlets and of a vacuum pump. The one thing to be careful about is that where radiators or coils are at, or near, the end of supply lines the orifices will have to be a little larger than those on radiators nearer the source of supply, to make up for pressure drop. Proper size of orifice can be determined from Data Sheet No. 48 (POWER, Sept, 1936). For all practical purposes one lb of steam per hr, at one lb pressure, will take care of 3 sq ft of radiation.

Brass disks can be ordered to fit union connections at inlets and proper size holes drilled in them for passage of steam. Reasonable care should be used in drilling a neat hole and reaming to proper size.

Proper use of orifices can balance a system; where radiation is too great smaller orifices can be used. The same centralized control possible with hot-water can be duplicated with steam under these conditions because with reducing valve and vacuum pump any differential can be maintained.

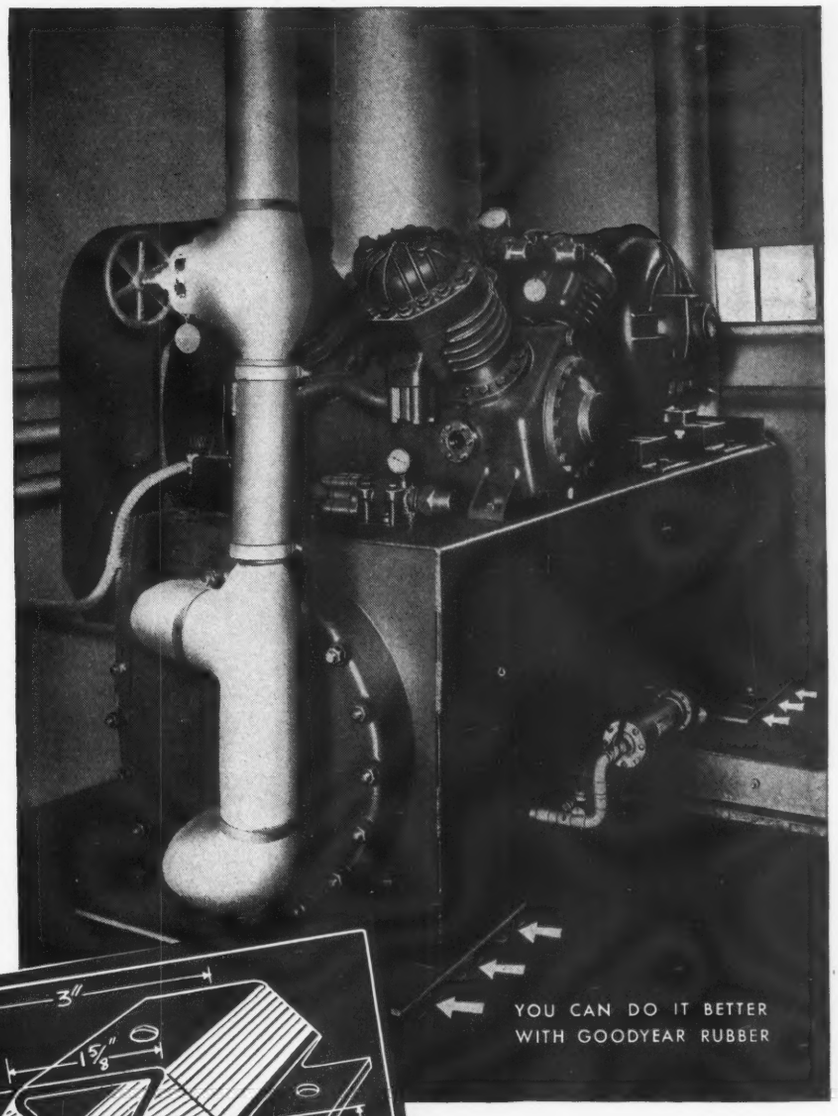
West Roxbury, Mass. G A BOHNENBERGER

Several Methods of Conversion

IT IS POSSIBLE to change a 2-pipe hot-water system to a direct-steam system by using hot-water flow pipes as supply lines and return pipes for condensate. The latter will be larger than necessary but will function satisfactorily. The existing insulation can be used if in sound condition.

The least expensive way to make the change is to convert to a 2-pipe low-pressure system without radiator traps. This has several objections; air valves are required on all radiators and unless pipe sizes are carefully proportioned, which would require considerable alteration of existing connections, steam will tend to

HERE'S A Silent Cure FOR ALL HIGH-SPEED MACHINES WITH Vibration Jitters



Air conditioner mounted on Goodyear rubber vibration dampener in Memphis store.

THE floor-shaking vibration, the rhythmic nerve-shattering 'ammer, 'ammer, 'ammer characteristic, of so many high-speed machines has met its match in Goodyear rubber. Today air conditioners, compressors, ventilating fans, generators and other jittery equipment are being cushioned to tiptoe silence by an ingenious Goodyear development—the Universal Vibration Dampener.

The amazing effectiveness of this rubber cushion is best illustrated by typical examples like these:

A printing press recently installed in a large Ohio hotel to print menus and programs caused so much vibration throughout the building that guests were seriously disturbed. On recommendation of the G.T.M.—Goodyear Technical Man—the press was mounted on Goodyear rubber dampeners. It is now inaudible, even in adjacent rooms.

In a mid-western office building there were many complaints about the noise of an automatic numbering machine used by one of the tenants. When it was cushioned on Goodyear rubber, people on the floor below thought their noisy neighbors had moved, the silence was so complete!

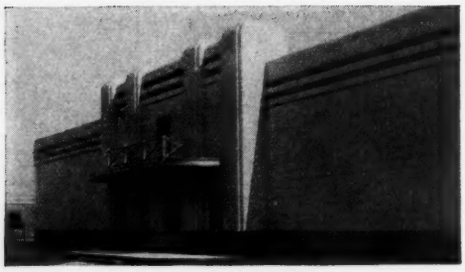
In mills and factories the dampener not only silences noise—it does away with excess machine-motion, permitting cleaner, quicker work on high-speed operations.

Elimination of noise and vibration is only one of the many modern industrial problems being solved by applications of rubber-to-metal. Abrasion, corrosion and excessive impact are others. Let the G.T.M. show you how you can do it better with Goodyear rubber. To have him call, write Goodyear, Akron, Ohio, or Los Angeles, California—or phone the nearest Goodyear Mechanical Rubber Goods Distributor.

THE GREATEST NAME IN RUBBER

GOODYEAR

A Centennial Product of The Greatest Name in Rubber

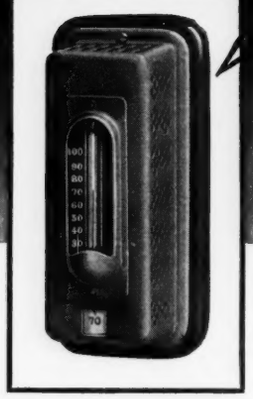


"WINDOWLESS" INDUSTRIAL BUILDING
with Complete Air Conditioning
CONTROLLED "BY JOHNSON"

Office and Research Building for National Aluminate Corp., Chicago, Illinois

Ambrose C. Cramer, Inc., Architects; Robert E. Hattis, Consulting Engineer, Chicago

THE "HEATING" CONTROLLER



THE "BRAIN" OF THE SYSTEM

THE "COOLING" CONTROLLER

Pictured above is the "control room", showing Johnson valves on the heating and cooling coils in the individual ducts which serve each room. In this windowless building, the occupants of each space determine the exact temperature which they desire. Then, each of the 61 Johnson room thermostats, the "brain" of this complete air conditioning system, calls for heating or cooling effect, automatically maintains the required temperature . . . The *adjustable sensitivity* of these Johnson "proportioning type" room thermostats is the distinctive feature. Each instrument is precisely balanced, *on the job*, with respect to the heating and cooling capacity of the units which it controls. The exact requirements of each room are met, without "hunting" or fluctuation of temperature . . . Each room thermostat controls two valves; a direct-acting, diaphragm-operated valve (the "heating" controller) for the hot water heating coil, and a reverse-acting valve (the "cooling" controller) for the cold water cooling coil. The cold water valves are "long-neck" pattern, allowing ample clearance for piping and pipe covering. When any room is up to temperature, its "heating valve" closes gradually. If complete closing does not allow the room to cool to the desired temperature, the "cooling valve" begins to open.

ALSO: JOHNSON CONTROL FOR INDUSTRIAL PROCESSES

JOHNSON SERVICE COMPANY
MILWAUKEE, WIS., AND DIRECT BRANCH OFFICES IN PRINCIPAL CITIES

back up through some of the return lines.

A much better scheme involves conversion to either a low-pressure or vacuum-return system, providing thermostatic traps on all radiators. If a hot well and boiler-feed pump of liberal capacity are now being used, it may be possible to utilize these for the new system, carrying just enough pressure on the steam main to insure condensate returning to the hot well. If not, it will be necessary to increase existing hot well and boiler-feed pump capacity or to install a vacuum pump. The latter will permit operation at sub-atmospheric pressures with resultant low-temperature steam in radiators, an advantage in mild weather.

In any event, piping should be arranged to drain quietly. This will mean regrading some of the present lines, particularly radiator run-outs, which should be pitched not less than ½ in. per ft, away from radiators. Drip pockets and traps should be provided at the foot of all steam risers and at low points in steam lines.

The question does not include sufficient data for estimating all costs involved. Average labor and material costs are:

Radiator supply valves, installed	$ 6.00 each
Radiator traps, installed	$ 9.00 each
Drip traps, including dirt pockets for risers and low points, installed	$15.00 each
Regrading radiator run-outs	$10.00 pair

The last item will vary with conditions encountered at the building but should not exceed the figure given.

Vallejo, Calif. T W Bean

No Reason Against Change

I see no reason why EAD can't change his hot-water system to steam. He does not state whether the present steam system is of the gravity or vacuum-return type. If he wishes to convert to a vacuum-return system it will be necessary to install a vacuum-return trap on the return end of each radiator. If he wishes to convert to a gravity-return system he can install one trap on several radiators using a check valve on each, with an air-vent valve. The steam system will require less radiation surface than the present hot-water system.

Waterbury, Conn. F W Carter

Pointers on Changeover

Nothing is known of EAD's layout but I assume it to involve several levels as forced circulation is required. This system can be converted to steam by installing orifice plates, air-vent valves, and individual traps on each radiator, using the present water-supply line, which is connected to the top of the radiators, for steam supply. Steam pressure must not exceed that for which the system was originally designed. The present return line can be used if it does not contain risers of excessive height but a free flow from traps is to be desired if possible. If a reducing valve is required, care must be taken to install suitable relief valves on the low-pressure side.

Saltville, Va. J C Porter

They put us in with the LIONS

The shop foreman gave Shell his toughest job... as a tryout!

IN up-state New York, there's a plant which has a shop foreman who operates on a pretty sensible principle when it comes to putting in a new oil.

He gives the newcomer the toughest job in the plant and lets him *prove* whether he's good or not. "Throwing 'em to the lions," he calls it.

The Shell man was no exception—and he welcomed the chance to prove the worth of Shell Lubricants under the toughest conditions.

This plant was working 18-8 chrome nickel on their automatic machines—and having plenty of trouble with these tough metals. The work was smoking, life of the tools was very short, and the finish in many cases was bad.

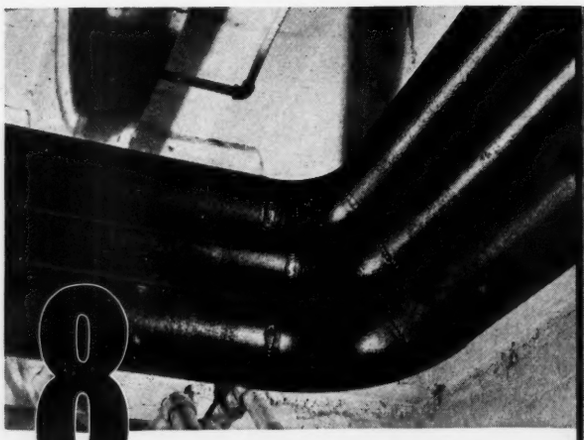
The Shell man went to work on these machines, conducting a series of experiments with the cutting oil. After he had completed his tests, he recommended to the foreman the correct type and grade of Shell Cutting Oil.

And the Shell man proved his product! No longer did the work smoke . . . finishes were smoother . . . yet the over-all cost of the Shell product was less than the oil formerly in use. To clinch the point, a check was kept on one nut-tapping machine, and it was found that production had been increased from 50 to 60 pieces per hour!

Have you a particularly tough, troublesome job in your shop? Shell would welcome the chance to show you how costs can be cut . . . production increased . . . with Shell Cutting Oils. These products are doing a great job in machine shops all over the country. Why not put them to work for you? There is a Shell office near you.

SHELL

SHELL *Cutting* OILS



8 features that mean *Better* Pipe Welding at *Lower Cost*

THREE factors determine the cost and value of every welding operation: The time it takes to prepare for welding; the time it takes to perform the welding; the soundness of the job when it is finished.

Thanks to the unduplicated combination of features illustrated here, these factors are best fulfilled by Taylor WeldELLS and other Taylor Forge Welding Fittings.

Less time is required to "get under way" when WeldELLS are used because complete marking of name, size, and weight is now rolled into every Taylor Forge Fitting. There is no hunting for fittings; no "sizing up"; no guessing; no mistakes.

Less time is required to do the job because the ends of all Taylor Forge Fittings are now clearly marked at 90° intervals to facilitate lining up. Moreover the accuracy of the fittings, the ample tangents and the clean, accurate machine-tool bevels assure a faster job and a better weld.

The finished job is better because it is made with a seamless fitting of engineered design in which wall thicknesses are never skimped and the crotch is reinforced to compensate for the greater strains that occur in this region.

It will pay you to study these features. They cut costs at every step. They make welding—the best method of pipe joining—*still better!*

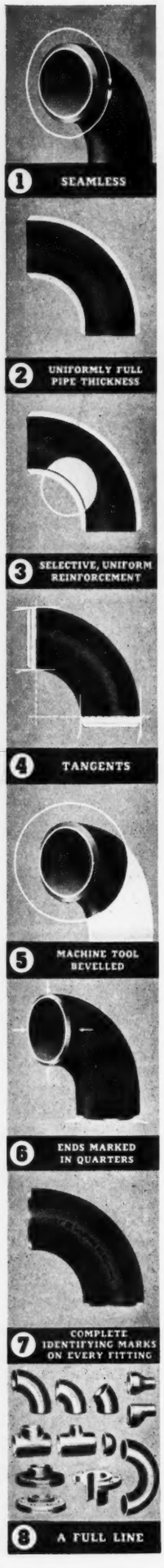
ASK FOR LATEST BULLETINS

TAYLOR FORGE & PIPE WORKS

General Offices and Works:
P. O. Box 485, Chicago New York Office: 50 Church St.

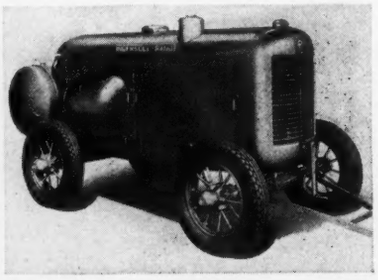
TAYLOR FORGE
***WeldELLS**
Seamless Pipe Fittings for Welding
★ Trade Mark Registered

INSIST ON THESE ESSENTIAL FEATURES


1 SEAMLESS
2 UNIFORMLY FULL PIPE THICKNESS
3 SELECTIVE, UNIFORM REINFORCEMENT
4 TANGENTS
5 MACHINE TOOL BEVELLED
6 ENDS MARKED IN QUARTERS
7 COMPLETE IDENTIFYING MARKS ON EVERY FITTING
8 A FULL LINE

New Equipment

(Continued from page 126)



mostatic control replaces adjustable curtain and air intake is now located on top of roof. Bell housing connection is used on all models, and entire assembly is mounted on pressed steel frame.

Ingersoll-Rand Co, 11 Broadway, New York, N. Y.

Flow-Ratio Control

UNIT controls automatically rate of flow of one fluid in definite ratio to flow of second fluid. Consists of two instruments, standard flow recorder, and standard flow-recorder controller. Rate of flow measured and recorded by one instrument, which sets control point on second. Latter then records and controls flow according to ratio selected. Catalog No. 1051.

Bristol Co, Waterbury, Conn.

Pneumatic Scaling Hammer

"ROTO" pneumatic scaling hammer descales boiler drums, headers, evaporators, and drills holes in concrete. Also used to chip anything from wood or steel. Hammer weighs less than 6 lb, and operates

from 40- to 90-lb pressure, consuming 10 cu ft of free air per min. Ground steel plunger only moving part, and flat chisel and star drill are furnished with each hammer.

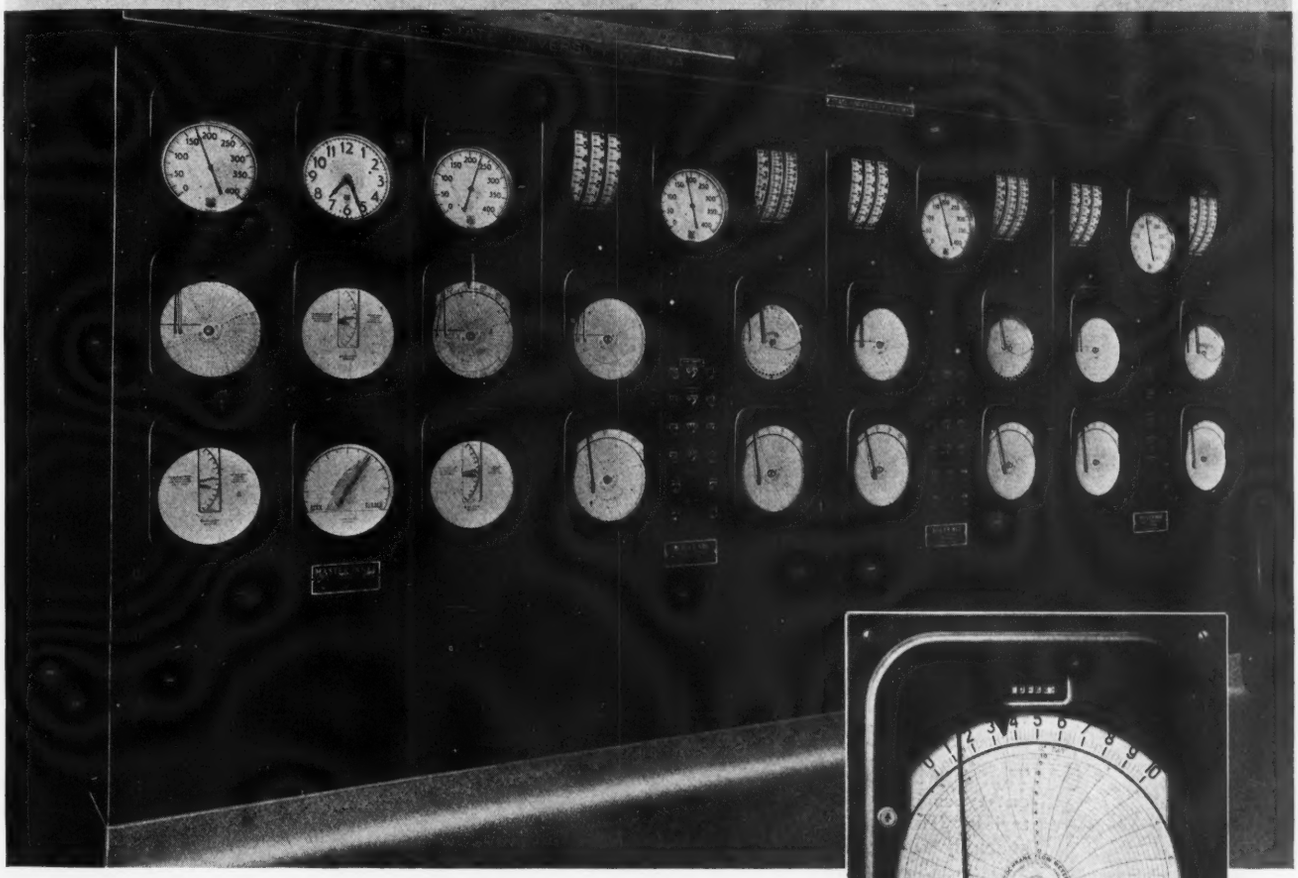
The Roto Co, 134 Sussex Ave, Newark, N. J.

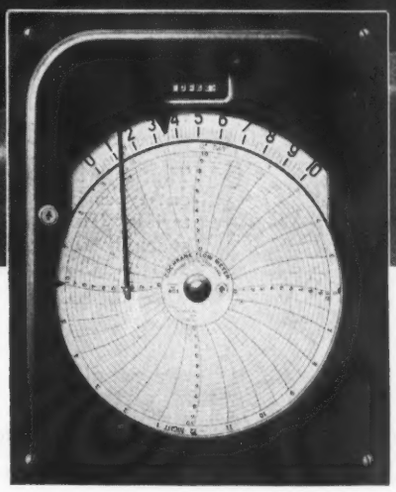
Electric Hammer

DESIGNED for heavy construction drilling and cutting, and for large plant mainte-

For Accuracy that Spells Economy

. . . COCHRANE FLOW METERS





Recording—2,000,000 lbs. of Steam per Day

The Cochrane Flow Meter shown above with other associated instruments are measuring the feed water and steam output of a modern plant where demand varies between 500,000 and 2,000,000 pounds per day. These meters provide complete information on operation and efficiencies.

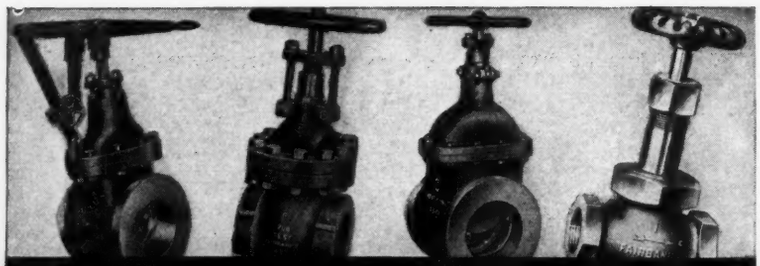
Write for Bulletin No. 2096 on Electrical Flow Meters and No. 2094 on Mechanical Flow Meters.

Why not investigate the possible savings in your power plant? Cochrane Flow Meters are made in a variety of styles and combinations in both electrical and mechanical types to fulfill the different exacting needs of those concerned in maintaining plant economies.

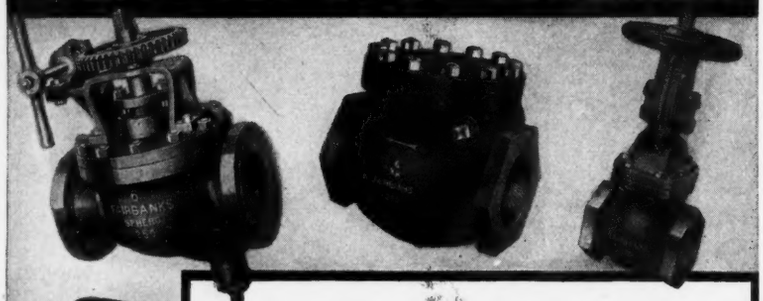
COCHRANE CORPORATION • 3133 N. 17th Street, Philadelphia, Pa.

COCHRANE

WATER SOFTENERS • DEAERATING HEATERS • FILTERS • BLOW-DOWN EQUIPMENT • VALVES • FLOW METERS



Save Work and Money By Using the Right Type of Valve for Each Condition



A valve right for one purpose is often unsuitable for another condition. Large sums of money are wasted by using the same type of valve for every application, for there is no universal valve.

That is why Fairbanks make so many different types of valves, in so many different materials. There is a Fairbanks Valve designed specially for practically every service between 125 and 350 lbs. steam working pressure.

Without obligation, our representative will gladly assist you in choosing the type of valve that long experience has proved the best for any condition.

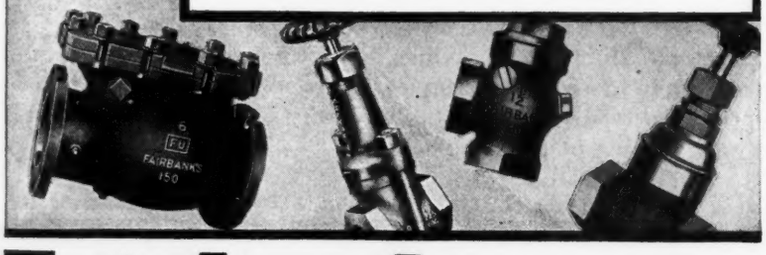
Distributors everywhere carry a substantial stock of Fairbanks Bronze and Iron Valves.

Write for our Catalog No. 21.

The Fairbanks Company

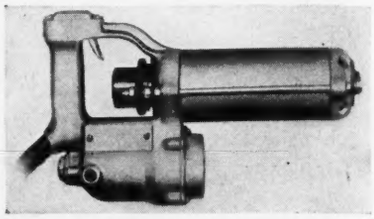
397 Lafayette St. New York, N. Y.

Boston, Pittsburgh—Distributors In Principal Cities
Factories: Binghamton, N. Y., Rome, Ga.



Fairbanks . . .
Bronze and Iron Valves

nance work, electric hammer is operated from ordinary 110-volt ac lighting circuit. Holes up to 2 in. can be drilled in the hardest concrete by using star drills, and by using stone points or cold chisels, the hammer will cut through masonry floors and walls for risers, doors, windows, etc. Hammer uses patented construction made up of two magnets wound around a barrel



in which is a free moving, heavy piston that strikes directly on the shank of the tool being used, and in addition, has small high speed blower in the handle, used to keep magnet windings cool. The hammer is 16 in. over-all, 3½-in. in diameter, and weighs 25 lb.

The Syntron Co, 492 Lexington Ave, Homer City, Pa.

Burst-Proof Steam Hose

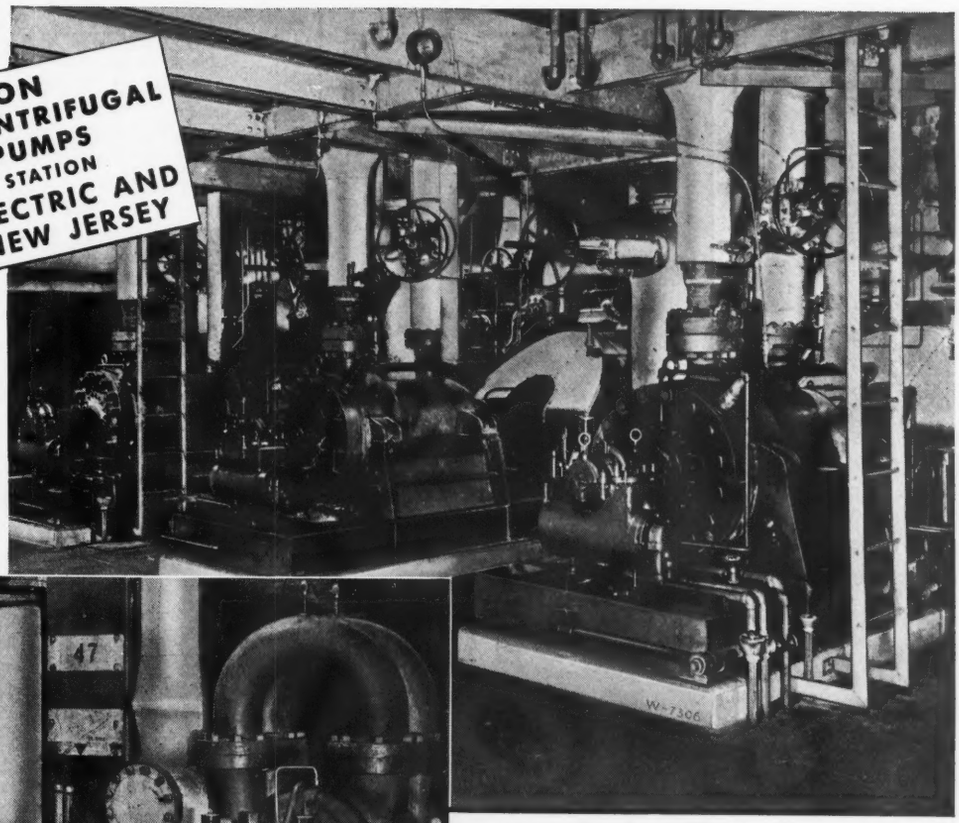
IMPROVED hose, for saturated steam pressures up to 200 lb psi, or superheated steam to 390 F, has tube made from improved heat-resisting compound and capacity to resist steam penetrating into hose carcass and cover. On sizes 1¼-in. and larger, one ply of woven asbestos fabric and spiral wire reinforcement is placed between wire braids. In smaller sizes, braided asbestos is used to prevent kinking and collapse. Available in sizes from ⅜-in. to 2½-in.

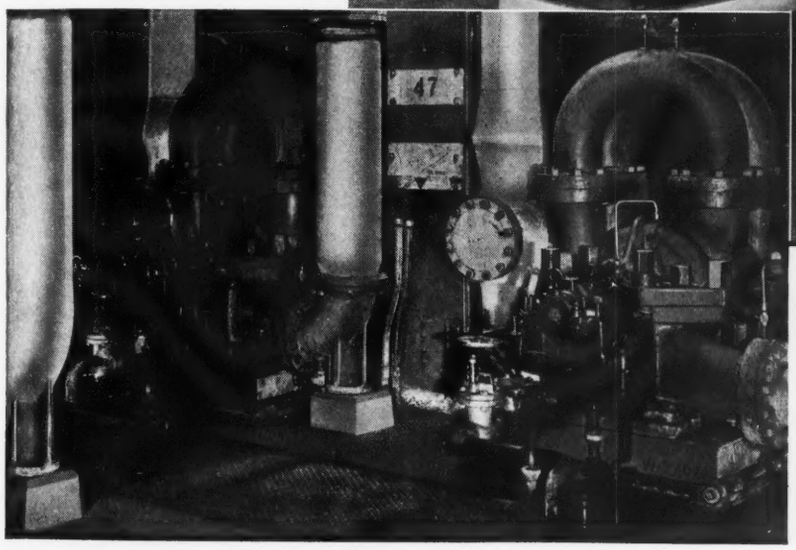
B F Goodrich Co, Akron, Ohio.

Refrigeration Controls

HYDRAULIC-ACTION temperature controls utilize expansion characteristics of solid liquid charge which operate stainless-welded-steel diaphragm and enclosed switch with wiping contacts. Controls operate from —20 to +75 F. Device said to be immune to ordinary conditions

WORTHINGTON
HIGH PRESSURE CENTRIFUGAL
BOILER FEED PUMPS
ESSEX GENERATING STATION
PUBLIC SERVICE ELECTRIC AND GAS COMPANY, NEW JERSEY





Above—Three 6" 6-stage Worthington Boiler Feed Pumps, steam-turbine-driven, capacity of 650,000 lb. per hr. each . . . 200 p.s.i. suction pressure and 1765 p.s.i. discharge pressure, 220° F., 3570 r.p.m.

Left—Two of three 6" Worthington Boiler Feed Pumps, motor-driven, capacity of 650,000 lb. per hr. each . . . 200 p.s.i. discharge pressure, 220° F., 1750 r.p.m.

A steadily growing list of important users gives evidence of sustained confidence in Worthington high pressure centrifugal pumping units.

In every case the high initial efficiency of these units is being steadily maintained because Worthington has always built to the principle that the only real economy can be obtained by producing equipment that will continue to give high operating efficiencies and assure uninterrupted performance through successive years of service.

The complete Worthington line of Centrifugal Boiler Feed Pumps covers without compromise every condition, from the smallest capacities and medium pressures, to the largest high pressure units ever built.

MEMBER HYDRAULIC INSTITUTE U.S.A.

200 lb. per sq. in. to 3000 lb. per sq. in.

CP9-1

PRODUCTS OF
WORTHINGTON
AIR CONDITIONING EQUIPMENT
REFRIGERATION AND ICE PLANT EQUIPMENT
AIR AND GAS COMPRESSORS
STEAM TURBINES
DIESEL ENGINES
GAS ENGINES
CONVERTIBLE GAS-DIESEL ENGINES
CENTRIFUGAL HIGH-PRESSURE BOILER FEED PUMPS
DIRECT-ACTING STEAM PUMPS POWER AND ROTARY PUMPS
DEEP WELL, SUMP, AND DRAINAGE PUMPS
STEAM CONDENSERS AND AUXILIARIES
VACUUM PUMPS
STEAM-JET EJECTORS
PORTABLE COMPRESSORS AND AIR TOOLS
For street . . trench . . conduit service
V-BELT DRIVES LIQUID METERS

WORTHINGTON PUMP AND MACHINERY CORPORATION

ATLANTA BOSTON BUFFALO CHICAGO CINCINNATI CLEVELAND DALLAS DENVER DETROIT EL PASO HOUSTON KANSAS CITY

General Offices: HARRISON, NEW JERSEY

Representatives in Principal Cities of Foreign Countries

LOS ANGELES NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH ST. LOUIS ST. PAUL SAN FRANCISCO SEATTLE TULSA WASHINGTON

"PALMETTO"

THE PACKING
for
Boiler Room Requirements

Auxillary Engines and Pumps • Stokers • Soot Blowers
Valve Stems • Heater Valves, etc.

DOES NOT GET HARD
EASY TO INSTALL — EASY TO REMOVE

Send for Testing Sample • *No Obligation* • *State Size*

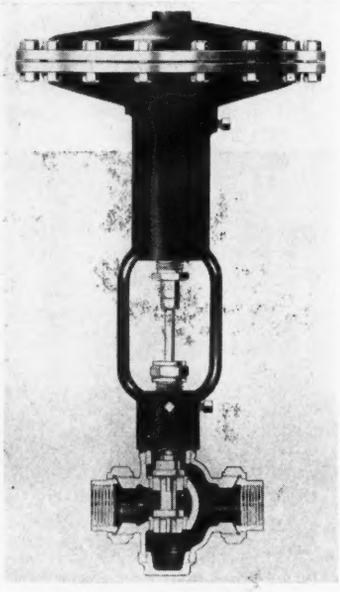
GREENE, TWEED & CO.
Sole Manufacturers 101 Park Ave., New York, N. Y.

of vibration. Switches enclosed to prevent entrance of dirt, and heavy load capacity is feature of all models. Single-pole, single-throw (double break) switches standard with controls.

Julien P Friez & Sons, Baltimore, Md.

Reducing Valve

TYPE 57U union-end regulator designed to receive varying or high pressure at inlet and automatically deliver constant reduced pressure to outlet. Can be used with water, steam, air, oil, or gas. Type illustrated is spring actuated and can be installed with diaphragm above or below



pipeline. Available in Duromite bronze or stainless steel, and V-port or throttling inner valve furnished on order. Sizes from ½- to 2-in., screwed globe, union end, all bronze body, for pressures of 250 lb and 450 F. Catalog C.

Fisher Governor Co, Marshalltown, Iowa.

Torque-Indicating Wrench

No. 59 is constructed of heavy, ground, spring-steel shaft with pointer which remains rigid. Even tension on bolts and studs obtained by pulling on handle grip, which bends spring steel shaft. Scale, calibrated from 0 to 200 ft lb is on shaft near handle grip and moves under pointer as pull is exerted on shaft. Permanently equipped with ½-in. square reflector and can be used with all ½-in. square-drive sockets and attachments. Weighs 3 lb and over-all length is 23 in.

Bonney Forge & Tool Works, Allentown, Pa.

Automatic Stokers

1939 LINE of automatic stokers, with feeding capacities from 25 lb of coal per hr to 1200 lb per hr, available in 20 sizes. Model *B*, illustrated, has electrical safety device that stops motor in case of overload, which will automatically reset after overload is removed. Included with new

86.3% OF APEXIOR ORDERS IN 1938 WERE REPEAT ORDERS

Users of APEXIOR Certify Its Value to You

IN boilers throughout America—under the all-seeing eyes of Power Engineers, APEXIOR Protective Coating has proved its value time and time again.

The CERTIFICATION of this statement comes from our Sales Records which show that — over the past 7 years — 80.3% of each year's orders have come from *previous users* of APEXIOR. In 1938 the percentage increased to 86.3%.

These buyers know that the use of APEXIOR has raised their standards of boiler maintenance. They know from experience that this unusual Protective Coating actually seals the surfaces of their boiler tubes and drums — lengthening metal life and making cleaning easier.

It is axiomatic that when 86% of a group of "hard-boiled" power engineers (who take *nothing* for granted) reorder APEXIOR Protective Coating each year, that this material must be a valuable aid in maintaining a high operating standard of condition of the boiler metal.

The record, we believe, speaks for itself. We suggest that *you* investigate APEXIOR Protective Coating to learn its profit possibilities for your plant. Write for Bulletin 1300.

APEXIOR NUMBER 1

The accepted Protective Coating for the preservation of boiler tubes and drums. It is hand brush applied to the interior of drums and applied to the interior of tubes with, an expanding brush attached to the ordinary air turbine.

APEXIOR REG U.S. PAT. OFF.

CERTIFIED IN SERVICE BY ITS USERS

THE DAMPNEY COMPANY OF AMERICA

PROTECTIVE COATINGS FOR STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

HYDE PARK, MASSACHUSETTS

Atlanta · Chicago · Boston · New York · Detroit · Philadelphia

Engineering Sales Representatives — Pittsburgh, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B.C., Montreal, P.Q., Havana, Cuba, Manila, P.I., Honolulu, T.H., Marine Dept., 114 Liberty St., New York, N.Y.

For power plant fires arm yourself with the fastest known extinguishing agent. Lux carbon dioxide fire extinguishers kill fires with split second speed.

Lux extinguishers handle with ease the worst types of fires . . . even dread running-gasoline fires. Flaming fuel oil and lubricants snuffed out in a flash. In electrical fires, Lux not only gets the fire out fast: it does no damage to delicate equipment, no harm to workers. Lux carbon dioxide is clean. dry, leaves no mess.

LOW-COST MAINTENANCE

You avoid maintenance expense with Lux extinguishing equipment. Requires no annual recharging. Occasional weighing gives a quick check-up.

For power plant protection get Lux Built-In Systems or Lux portable extinguishers. Send the coupon and get the facts. Write today.

Walter Kidde & Company

527 West Street, Bloomfield, N. J.

Tell me about fire protection for the hazards I have checked below.

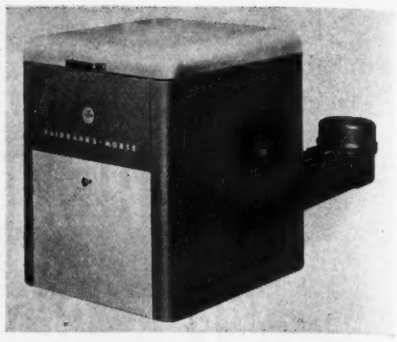
....Engine Rooms	....Generators	....Pipe Tunnels
....Fuel Storage	....Oil Switches	....Transformers

Other Hazards .....

Name .....

Company .....

Address .....

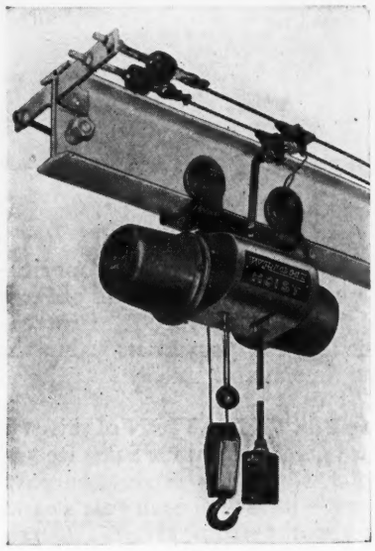


line are three improved controls, thermostate, boiler or furnace control, and fire timer. Height of hopper reduced without loss of storage capacity. Publication AGB4002.

Fairbanks-Morse & Co, Chicago, Ill.

Electric Hoist

"SPEEDWAY", light-weight, low-cost, wire-rope electric hoist has capacities from 250 lb to 750 lb and speeds 15 to 43 fpm. Standard construction includes fully enclosed ball-bearing motor, anti-friction bearings, cut-alloy-steel spur gears, multiple-disk solenoid brake, pushbutton con-



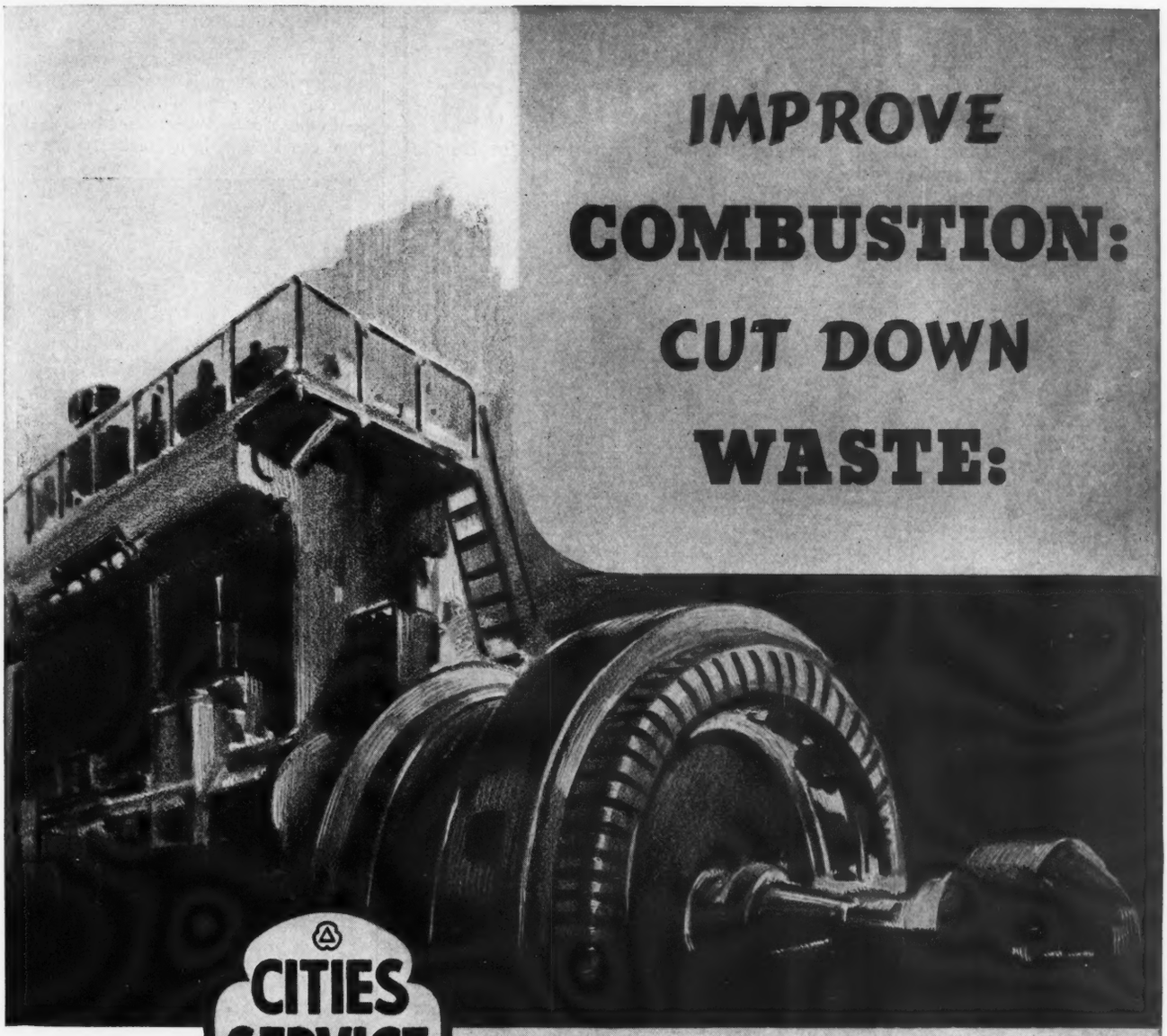
trol, preformed hoisting cable. Made in three types: for lug suspension, hook suspension, or mounting on trolley.

Wright Manufacturing Div, American Chain & Cable Co Inc, York, Pa.

Vernier-Set Timers

SERIES 2800, Type 2803 provide visible timing adjustment for various industrial applications, including automatic machinery, timing of furnace operations, etc. Four arrangements of load circuit possible with timer. Desired load circuit condition is selected by adjustment of two slides, movable to the left or right, and by locations of bridge connections. Dial ranges includes from 0 to 60 min, and timer has scale division from 1 to 30 seconds.

Automatic Temperature Control Co, Inc, 34 E Logan St, Philadelphia, Pa.



● Efficient Diesel operation, freedom from breakdowns and tie-ups demand efficient lubrication. Only lubricants that stand up—lubricants engineered to the job—can give efficient lubrication.

Cities Service Diesel lubricants are *Service Proved*. They have been tested—proved by years of service—to be lubricants that give outstanding service.

The Cities Service Lubrication Engineers have a wealth of experience in prescribing and checking results in the Diesel lubrication field. You can draw on this background, this experience, to answer your lubrication problems. The Lubrication Engineers' Service is free.

It will also profit you to investigate our Industrial Heat Prover—a by-product of our research in Diesel engine operation. This device registers, continuously and instantaneously, changes in the amount of oxygen and combustibles present in exhaust gases. It will enable you to burn your fuel more efficiently—savings will result. Let us tell you how you can obtain the use of one.

A new booklet, "Diesel Engine Lubrication" is now on the press. Write for your free copy today.

CITIES SERVICE OIL CO.
SIXTY WALL TOWER—ROOM 1626P, NEW YORK, N. Y.

Please let me know how I can get Heat Prover Service.....(check box) ☐

Please send me a copy of your *Free* folder "Diesel Engine Lubrication".....(check box) ☐

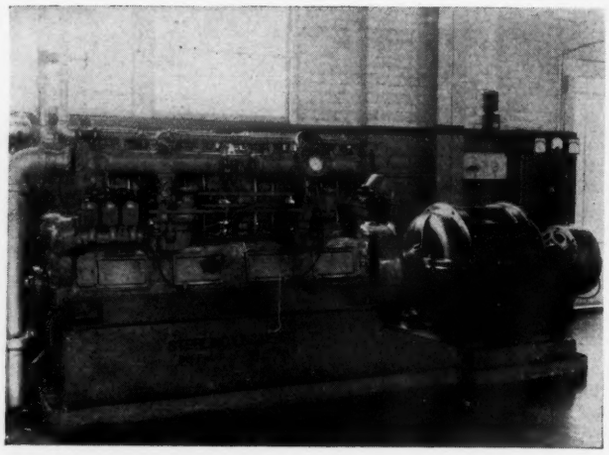
*Name*_____

*Address*_____ *City*_____

SERVICE PROVED INDUSTRIAL OILS

NEWPORT NEWS, VIRGINIA STANDBY GENERATOR SET

Typical of the custom of providing emergency power, for any contingency, in municipal water works.



STERLING HIGH DUTY · INTERNAL COMBUSTION ENGINES

Newport News is equipped with a 200 K.W. Crocker Wheeler Generator 1200 R.P.M., direct driven by Sterling Viking 6-cylinder 425 H.P. gasoline engine.

Emergency Power is available within a few minutes if these units are manually started—a few seconds, if automatic.

STERLING ENGINE COMPANY

Home Office and Plant,
1270 NIAGARA STREET,
BUFFALO, NEW YORK

Dept. C-1

Branch Office,
900 CHRYSLER BLDG.,
NEW YORK, N. Y.

Buell Dust Collectors bring you that combination of high efficiency and low cost which the patented Van Tongeren system is demonstrating in more than 1000 installations.

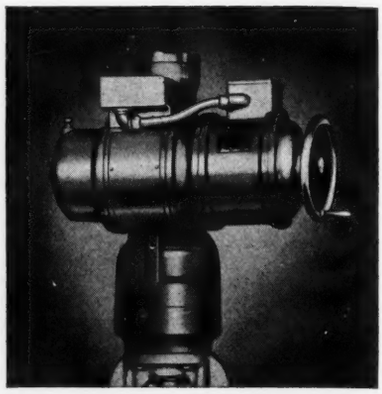
Those installations are earning the good will of workmen and of entire communities. They are earning equally important and more tangible profits in the salvaging of valuable dusts, the processing of a great variety of products, the reduction of many operating and overhead costs.

Ask us for *Bulletin D81* (on industrial dusts) or *Booklet A93* (on fly ash). Either, or both, will be sent free to any managing executive or operating engineer.

The Only Cyclones with a Dust Pocket

Valve Actuators

MULTI-POWER hydraulic valve actuator said to provide positive opening and closing on globe, gate, butterfly, rotary plug, and other similar valves. Non-inflammable fluid can be used in hydraulic system, and



weather- or explosion-proof motors can be supplied on order. Emergency hand operation provided capable of exerting pressure to 1800 lb psi. Valve said to have longer life due to elimination of severe operating shocks. Hammer blow normally used to loosen seated gate unnecessary with multi-power design.

Automatic Temperature Control Co, 34 E Logan St, Philadelphia, Pa.

pH Meter

FLOW-TYPE Electrode assembly of pH meter can be incorporated in piping to give direct measurement of pH fluctuations on process solutions. Consists of porcelain enamel flow chamber with standard 1-in. inlet and ¾-in. outlet pipe connections. Electrodes and temperature-compensating

thermometer are held in stainless steel cover plate, and gaskets permit moderate flow pressures to be maintained through the chamber without leakage. Electrodes are internally shielded against electrostatic interference and can be supplied with leads up to 500 ft in length.

National Technical Laboratories, Pasadena, Calif.

Unit Air Conditioners

LINE of unit air conditioners, for industrial plants, stores, offices, etc, can be

A HIT!

GARLOCK BITAN LEATHER PACKINGS

ONE

always stands out!

LEATHER CUPS

FLANGE OR HAT PACKINGS

"U" and "V" PACKINGS

WASHERS-GASKETS-DISCS

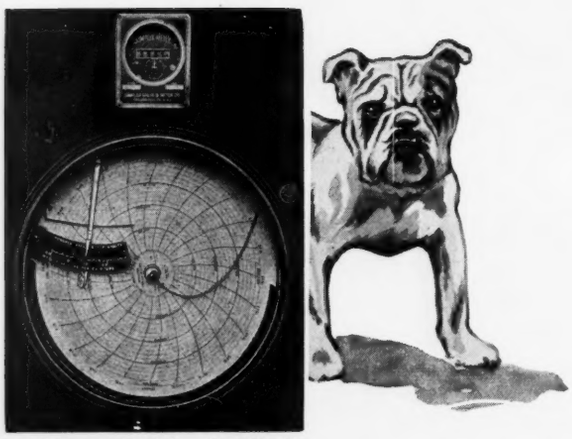
IN every baseball league one player gets the cheers of the crowd every time he steps up to the plate . . . for in every league, on the basis of past performance, *one always stands out.*

YOU are just as sure of a "hit" when you specify Garlock *Bitan* Leather Packings. *Bitan* is specially tanned and treated by an exclusive process to withstand extreme pressures and severe service . . . specially treated, too, for each particular service requirement. It's more resistant to heat, acids, alkaline solutions, etc., than ordinary leathers.

Garlock *Bitan* Leather Packings are produced in all forms and sizes. Write for descriptive folder.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.



The WATCH DOG that never needs to be fed

Alert and on the job, always accurate, Simplex Venturi Type Meter Registers keep constant guard over the steam requirements of all plant functions. A watch-dog and bookkeeper combined.

Sturdy in design, built for wide range service, Simplex Meters are selected by the discerning engineer for boiler feed, steam, condensate or evaporate flow measurements.

Simplex Meters can be furnished in any size and for operation under working pressures up to 2500 pounds.

Let Simplex Engineers help you with your metering problems.

WRITE TODAY FOR BULLETIN 52

SIMPLEX VALVE & METER CO.
6780 UPLAND ST., PHILA., PA.

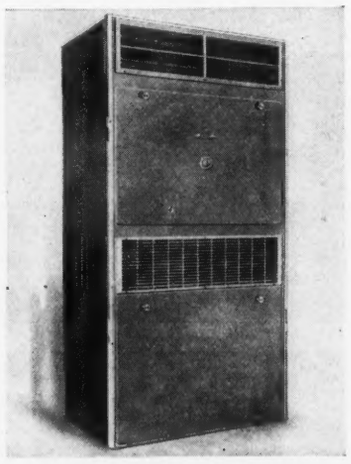
• clearances controlled—
• oil pressure maintained

On this diesel, **LAMINUM** babbitted shims (pat'd) are standard . . . for the important oil pressure control and precision adjustment of main and connecting rod bearing clearances. The same easy accuracy in service adjustments as in assembly! You simply peel off .002 in. (or .003 in.) laminations. Always a clean shim surface! Laminum sample on request.

LAMINATED SHIM CO., INC. 21-60 44th Ave., Long Island City, N. Y.
Cleveland Detroit Milwaukee
929

LAMINUM
Precision adjustment **SHIMS**

installed quickly, generally without interruption of working operations. Air is filtered and passed over cooling coils, which remove excess heat and moisture.



Blower maintains circulation continuously, and draws fresh air as needed. Units available in capacities of 3 and 5 tons refrigeration. Bulletin No. 520.

Frick Co, Waynesboro, Pa.

Bolt Threader

"TOLEDO" No. 101 provides positive die adjustment for over, under, and standard threads. Segmental dies may be reground and can be adjusted by turning cam ring. Threads bolts from ¼- to ⅝-in. rods U S S

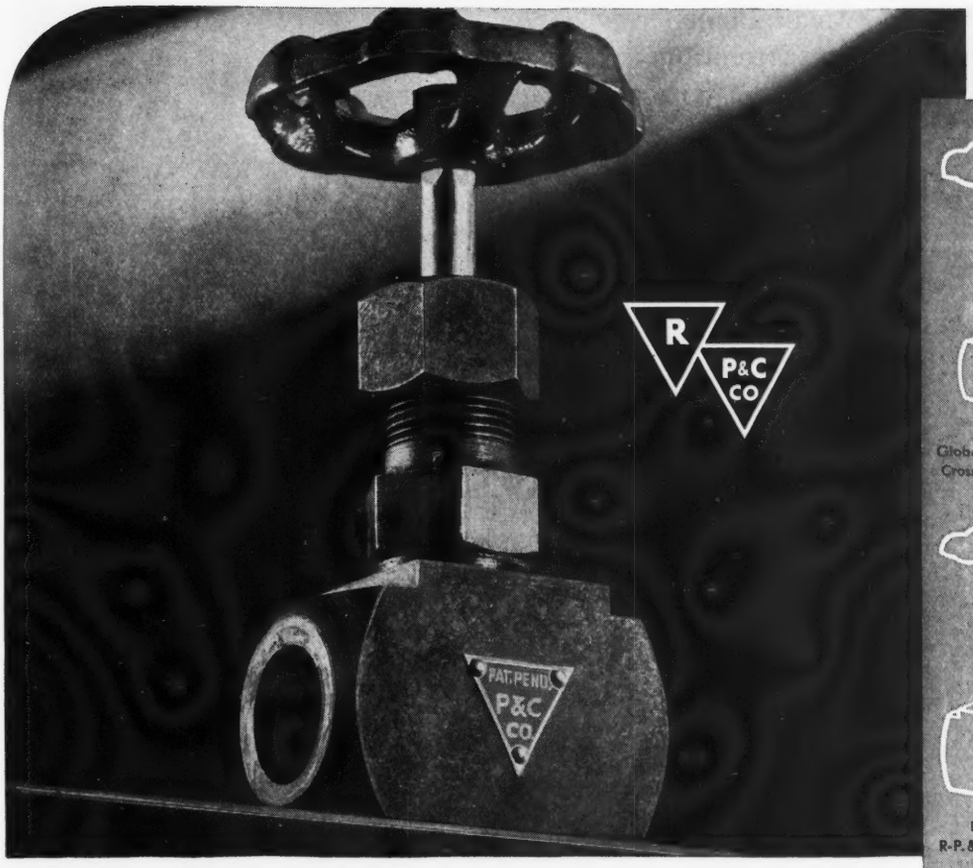
or S A E, and ⅜-, $\frac{7}{16}$-, and ½-in. pump rod. Die stock measures 17-in. over-all and weighs 2¾ lb.

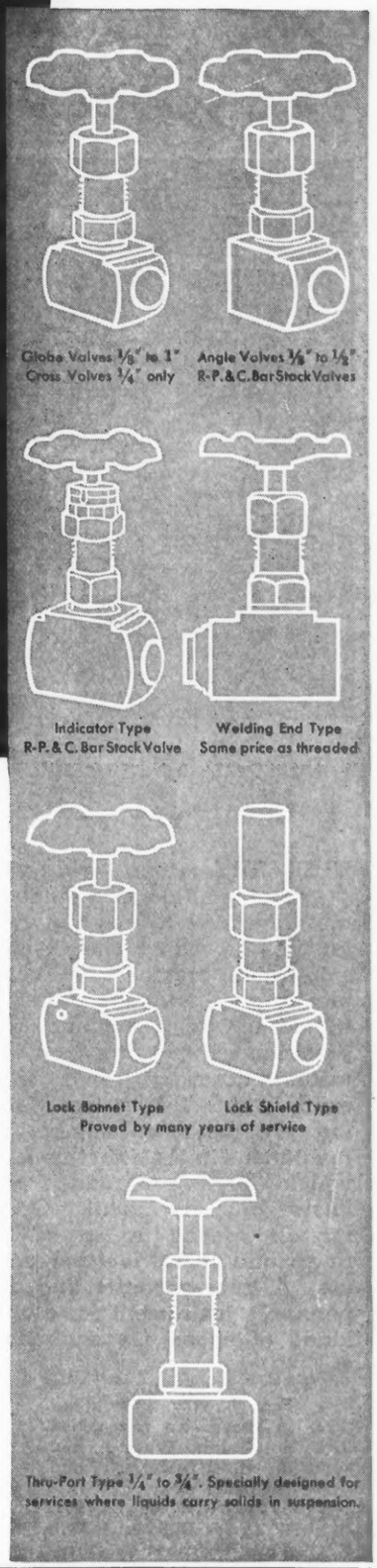
The Toledo Pipe Threading Machine Co, Toledo, Ohio

Boiler Gaskets

TWO TYPES of gaskets for manholes, handholes, and tube caps of all standard makes of boilers are made of steel, copper, Monel, etc for gaskets where surfaces are smooth. Asbestos and preformed metal strips wound spirally into round, oval, or irregular shapes compose irregular-surface gaskets. This type comes regularly in plain or zinc coated cold-rolled soft steel, and wide range of sizes.

Goteze Gasket & Packing Co, Inc, New Brunswick, N. J.




Globe Valves ⅛" to 1"
Cross Valves ¼" only
Angle Valves ⅛" to ½"
R-P.&C. Bar Stock Valves
Indicator Type
R-P.&C. Bar Stock Valve
Welding End Type
Same price as threaded
Lock Bonnet Type
Lock Shield Type
Proved by many years of service
Thru-Port Type ¼" to ¾". Specially designed for services where liquids carry solids in suspension.

Bar Stock Valves Originated by READING-PRATT & CADY

Today their rugged strength and accurate control provide definite economy for almost every industry

When the service is one that requires accurate control in valves up to 1-inch—and the valves must be able to withstand any commercial pressure and temperature—be sure to get complete data on READING-PRATT & CADY Bar Stock Valves.

Production of these valves ranges from a bronze globe number that handles pressure of 500 lbs. and 150°F. to valves of stainless steel and carbon steel with stellite discs designed for severe throttling uses up to 475 lbs. pressure at 1500°F. Production metals are bronze, carbon steel, 12/14% stainless, 18/8% stainless and combinations of the same—bodies made of bar stock on precision set machines.

Ask your jobber or write to us for recommendations that will result in your getting the service you look for.

READING-PRATT & CADY DIVISION
BRIDGEPORT, CONNECTICUT
Brass and Iron Valves • Steel Valves • Fittings

AMERICAN CHAIN & CABLE COMPANY, Inc.

AMERICAN CHAIN DIVISION • AMERICAN CABLE DIVISION • ANDREW C. CAMPBELL DIVISION • FORD CHAIN BLOCK DIVISION • HAZARD WIRE ROPE DIVISION • HIGHLAND IRON AND STEEL DIVISION • MANLEY MANUFACTURING DIVISION • OWEN SILENT SPRING COMPANY, INC. • PAGE STEEL AND WIRE DIVISION • READING-PRATT & CADY DIVISION • READING STEEL CASTING DIVISION • WRIGHT MANUFACTURING DIVISION • IN CANADA: DOMINION CHAIN COMPANY, LTD. • IN ENGLAND: BRITISH WIRE PRODUCTS, LTD. • THE PARSONS CHAIN COMPANY, LTD. • *In Business for Your Safety*

"JAGABI" HAND TACHOSCOPE

For Precise Measurements of Speed

THE Tachoscope will win your confidence immediately, because it uses the well-known "speed counter" and stop-watch method, but completely eliminates inaccuracies at starting and stopping. Its precision depends only on the lasting accuracy of a high grade watch mechanism. Giving you the exact number of revolutions in the exact time in which they were made, you *know* you are right! Good for all speeds up to 20,000 r.p.m. and 10,000 feet per minute. A truly accurate and dependable instrument for many kinds of speed measurement.

For showing fluctuations in speed, we recommend our Jagabi Types A and C direct-reading Hand Tachometers.

Write for Bulletin 1505-P, which describes an attractive variety of speed-measuring instruments.

JAMES G. BIDDLE CO.
ELECTRICAL INSTRUMENTS
1211-13 ARCH STREET PHILADELPHIA, PA.

Small Plants Get Attention

(Continued from page 101)

engineers omit unusable details. The power department, he said, would do well to work closely with the accounting department, leaving to the accountants the clerical details of assembling the cost figures.

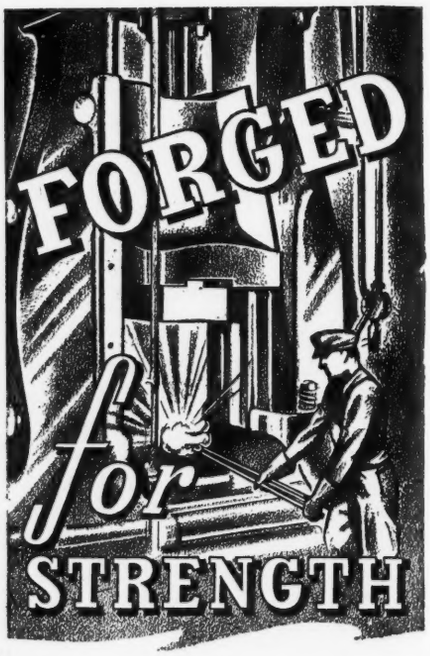
Mr Terry, designer of some of the world's largest hydro turbines and centrifugal pumps, stressed the use of models in the design of such machines. Complete mathematical analysis is impossible; cut and try is inevitable. Tests on models open the road to substantial improvements in performance.

In a session devoted to diesel power, C G A Rosen, Caterpillar Tractor Co, summarized the remarkable achievements of the diesel tractor and its indirect effect on the whole diesel field.

Following Mr Rosen, L H Morrison, editor of *Diesel Power*, said that diesel is almost always better than steam for the generation of power alone in plants under 5000 kw. For farms not economically reachable by utility service he recommended a manually started "farm lighting set" for household service plus a diesel tractor to power the farm proper.

Speaking of industrial diesel plants, Mr Morrison warned against excessive expenditures for standby equipment. He urged the utilities to reduce their rates for breakdown service as a matter of simple obligation to the public. The diversity factor is such, he said, that a given block of utility capacity will serve an aggregate of breakdown connections many times as large.

Fig. 3—Researchers discuss the fine points. R V Kleinschmidt (left), smoke-stack-gloom chaser of A D Little Co, talks shop with Max Jacob, Armour Institute's expert on properties of steam

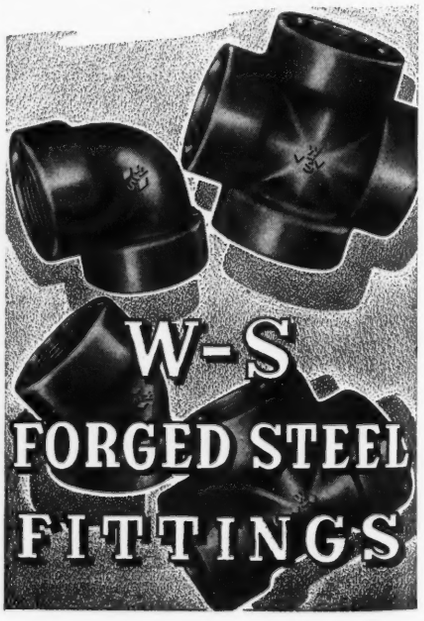


Pipe line failures on high pressure, high temperature systems, in addition to the danger involved are a source of excessive maintenance expense.

If you have been experiencing persistent pipe line trouble, W-S Forged Steel Fittings may be the solution to your difficulties.

Drop forged from open hearth steel, bored from solid forgings, W-S Fittings afford an extra margin of strength where it is vital and necessary.

Both screwed and socket welding fittings are available in a complete range of types and sizes. Order them from your distributor. The Watson-Stillman Co., Roselle, N. J.



Are Slime and Algae Impairing Your Condenser Efficiency?

You Can Reduce Heat Transfer Costs by eliminating Slime and Algae with Santobrite

Cooling water systems provide favorable growth conditions for algae and slime-forming organisms. Such organisms tend to clog the system, increasing heat transfer costs and necessitating added expense for cleaning. But these losses can be reduced by the use of Santobrite to eliminate slime and algae.

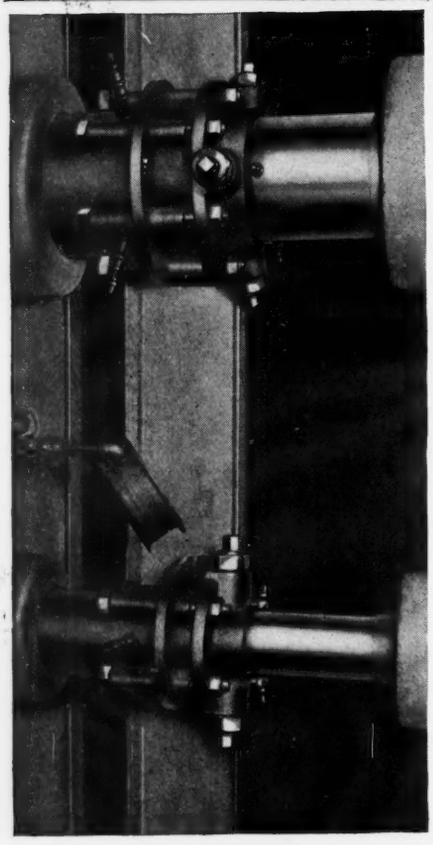
Santobrite, a Monsanto chemical highly toxic to these organisms, has been developed for use in recirculating cooling water systems where the water is not used for drinking or bathing purposes. Easy to handle and apply, Santobrite keeps the system free from growth, making for peak efficiency at all times.

Write today for Monsanto Technical Bulletin G-15. Monsanto Chemical Company, St. Louis, U. S. A.

MONSANTO CHEMICALS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

YARWAY
GUN-PAKT
EXPANSION
JOINTS



Big Automobile Company Uses 67 Yarway Joints

First purchased 3 years ago. Reordered 7 times to present total of 67 Yarway Gun-Pakt Joints, ranging in size from 3 in. to 14 in.

Why don't you select the Expansion Joint that is packed under full steam pressure. A twist of a wrench forces a special semi-plastic packing into the stuffing box by means of integral pressure guns. No need to remove old packing. New packing rejuvenates the old. No need to shut off steam. Write for Catalog EJ-1906.

YARNALL-WARING CO.
100 Mermaid Ave., Phila., Pa.

Conveyor Stokers

(Continued from page 87)

link construction permits meshing with teeth of driving and idler sprockets. Both general and individual takeups provide for maintenance of correct tension in chain, regardless of growth.

Retardation of ash flow, and a tight rear-end draft seal result from use of cover plates (one to each stationary grate section) held down by hook bolts fastened to the grate-supporting grid. The rear sprocket shaft is mounted under these plates, which protect sprocket assembly and "break" of traveling grate sections against abrasive action of ash.

Moving grate sections carry fresh fuel into the furnace, and the feed gate strikes off the fuel bed, making it level and of proper thickness for the fuel to be burned. Distillation of volatiles and buring of combustibles reduces volume of fuel, but retarding action of stationary grate sections keeps fuel under compression, closing up cracks and fissures. The effect of this action is to cause the fuel bed to move more slowly as the ash-pit end is approached. Rear cover plates introduce considerable resistance to flow of ash and so contribute to keeping fuel bed tightly packed against the incoming coal.

A single windbox supplies air for combustion; even fuel-bed thickness makes for more or less constant resistance over the entire grate surface. Dampers of the "V" type, at the rear, permit just enough air to pass to keep the fire alive, during banking and extremely light load periods.

Usual drive employs a constant-speed motor and variable-speed transmission, but any drive may be used.

Settings for stokers of this type differ from those for traveling or chain grates in the absence of the long low-hanging rear arch and narrow throat. As can be seen from the accompanying diagram, the front arch is retained. A fairly high setting, with plenty of black surface, is desirable. In an all-refractory furnace, 30,000 Btu per cu ft per hr heat release represents good design; for a partially water-cooled furnace the figure is 40,000. These units can be installed under boilers of from 2500 sq ft up and come in standard widths of 6 to 30 ft and standard lengths of 8 to 25 ft.

Compensating-feed stokers are not sensitive to fuel characteristics and will burn a wide range of coals, without changes in design or method of operation, and with good efficiency.

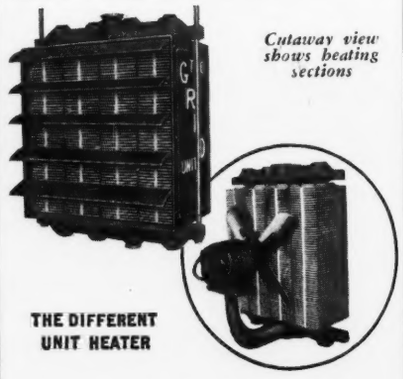
Save Air—Save Dollars
ROCKWELL
BLAST GATES

Threaded Slide Type

Flanged Slide Type

For Low Pressure Air
●
Slide Type
Butterfly Type
Kwikleen Type
●
Write for catalog No. 3760
●

W. S. ROCKWELL COMPANY
50 CHURCH ST., NEW YORK



YOU CAN DEPEND ON
GRID UNIT HEATERS

. . . No electrolysis
. . . More air changes per hour
. . . Do away with maintenance
. . . Long life of unit

Send for complete details

THE UNIT HEATER & COOLER CO.
Wausau, Wisconsin
Offices in principal cities

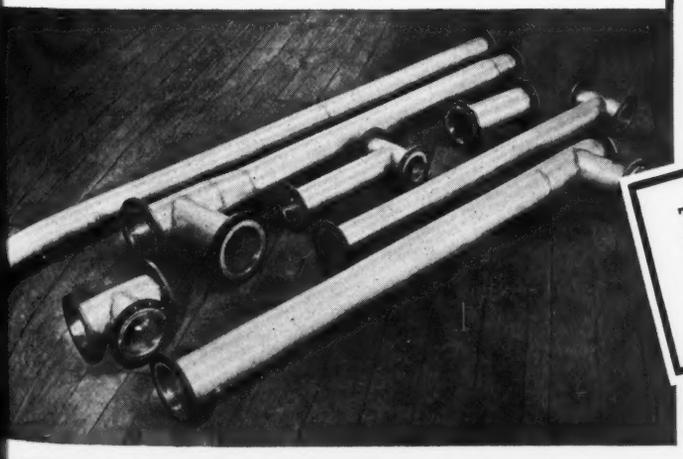
GRID
UNIT HEATER

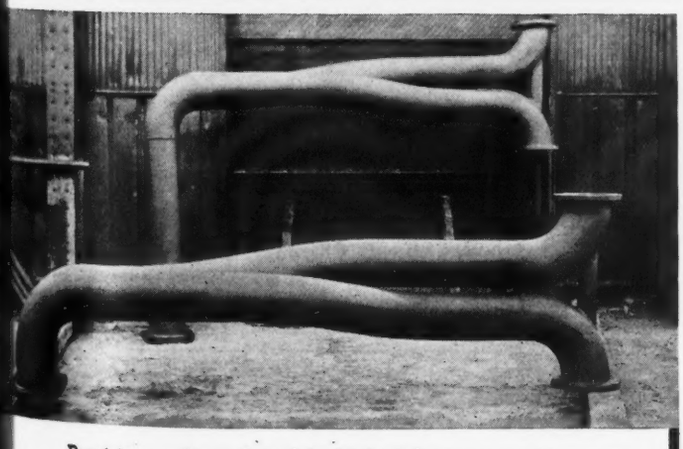
PITTSBURGH PIPING *PREFABRICATED* PIPING CONTRIBUTES TO THE EFFICIENCY OF MODERN PAPER MILLS

Expansion bend on all-welded high pressure steam system for a large Southern kraft mill. All steam, water and process lines for this modern plant were pre-fabricated and erected by Pittsburgh Piping.

• • •

Longer life outweighs the higher first cost of stainless piping for corrosion handling lines. In order to supply the finest type of fabricated stainless pipe and vessels, Pittsburgh Piping founded a separate Alloy Division 6 years ago. Below: Stainless Type No. 347 welded piping for a Maine paper mill.





Precision workmanship of the highest degree was necessary in pre-fabricating this digester piping.

The illustrations on this page show some of the Pittsburgh Piping pre-fabricated piping that is in service in practically every modern paper mill throughout the country.

Pittsburgh Piping not only is thoroughly familiar with problems peculiar to the paper industry but also knows how to pre-fabricate and erect piping economically and for most efficient plant operation.

Whether you require a few feet of stainless piping or a complete steam or process system, get in touch with your nearest Pittsburgh Piping district office.

PITTSBURGH PIPING & EQUIPMENT CO., 10 FORTY-THIRD ST., PITTSBURGH, PA.

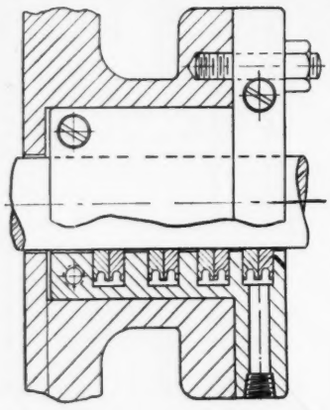
Woolworth Bldg., New York Occidental Bldg., Indianapolis Peoples Gas Bldg., Chicago General Motors Bldg., Detroit
Public Sq. Bldg., Cleveland 10 High St., Boston 1st Nat'l. Bank Bldg., Charlotte 525 Market St., San Francisco

This swivel arrangement for filling diffusers from cyclone is a marvel of simplicity. Guesswork in its operation was eliminated by pre-fabricating to close tolerances under controlled Pittsburgh Piping shop conditions.

FROM MAINE TO ARKANSAS you will find Pittsburgh Piping Pre-fabricated Piping in Leading Paper Mills.

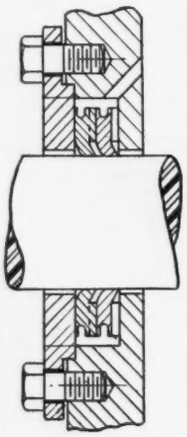
Pittsburgh Piping Welding Elbows made from Stainless Strip simplify fabrication, cut piping costs. Made in 2" to 6" sizes and stocked in analyses suitable for paper mills.

FRANCE
Metal Packing



Reduces Friction

Due to its long-wearing qualities and because it reduces friction to the minimum, France Metal Packing has been adopted as standard equipment by numerous engine and compressor builders. Accurate and prompt service for complete sets or renewals for existing packing cases.



Saves Oil

The oil return packing illustrated at left shows how crankcase oil is conserved with this type of installation. Used for years . . . the world over. Write for catalog of commonly used types and list of users.

THE FRANCE PACKING CO.

Tacony, Phila., Penna.

Sold on approval
Satisfaction Guaranteed

Original
FRANCE
METAL PACKING

STRAWS

(*Continued from page* 108)

ington, plans power house at Fourth and Limestone Sts, for central-heating service. Bids will be asked soon. Frankel & Curtis, McClelland Bldg architects.

LOUISIANA——Pure Ice Co, 1208 Hodges St, Lake Charles, plans 1-story addition to ice-manufacturing plant. Cost over $35,000.

Delcambre will award contract for installation of municipal gas distributing system, including control station. Randolph & Middleton, Inc, Citizens' National Bank Bldg, Hammond, consulting engineers.

Houma plans pipeline system for municipal natural-gas distribution, with control station. Estimates of cost being made. Baker Smith, city engineer.

Minden considering improvements in municipal electric power plant, including engine-generator unit. Estimates being made.

MASSACHUSETTS —— Water Dept, Brookline, W B Bushway, supt, plans improvements in pumping station for water system at West Roxbury. Myles S Richmond, 201 Devonshire St, Boston, architect.

MICHIGAN——Mount Morris plans water-softening plant for municipal water system. Appropriation has been secured through Federal aid.

State Dept of Institutions, State Office Bldg, Lansing has low bid at $155,865 from Bassler-Carter Co, 3900 Granby St, Detroit, for equipment for power house at Michigan Children's Village, Coldwater, and will make award soon.

Holland contracted Allis-Chalmers Mfg Co, at $340,000 for two 7500-kw steam turbine-generator units and steam-driven exciters for municipal power plant. Also let contract to C H Wheeler Mfg Co, for two surface-condensers at $57,000. Awards will be made soon for boiler units, and feedwater heaters. Giffels & Vallet, Inc, Marquette Bldg, Detroit, and Hamilton & Weeber, Grand Rapids, consulting engineers.

Bd of Directors Michigan Home and Training School, Lapeer, has low bid from Lorne Plumbing & Heating Co, 641 West Congress St, Detroit, at $46,935 for improvements in power house at institution and installation of additional equipment. Award will be made soon. E R Little Co, Inc, Ford Bldg, Detroit, consulting engineer. State Dept of Institutions, Lansing, in charge.

Mason City contemplates municipal electric plant. Estimates will be made soon. Arthur W Jewett, mayor, heads project.

American Forging & Socket Co, Pontiac, plans 1-story plant addition, 120 x 340 ft, for production of automobile body hardware. Cost over $125,000 with machinery and power equipment. L J Heenan, Pontiac, architect.

State Dept of Institutions, State Office Bldg, Lansing, has low bid from Wickes Boiler Co, Saginaw, at $77,492 for boiler unit for power house at Kalamazoo State Hospital, Kalamazoo, and will make award soon.

State Dept of Institutions, State Office Bldg, Lansing, plans improvements in power plant at Michigan State College, East Lansing, including equipment. To arrange appropriation of $500,000 for work.

MINNESOTA —— Bd of Scott County Commissioners, Shakopee, will contract soon for addition to boiler plant at court house, with new boiler unit. Toltz, King & Day, Inc Pioneer Bldg, St. Paul, architect.

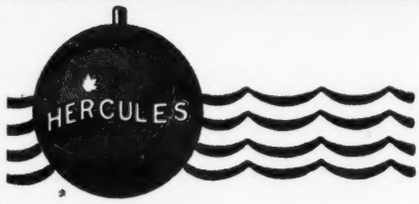
Jackson will contract soon for diesel generating unit for municipal power plant. Burlingame, Hitchcock & Estabrook, Sexton Bldg, Minneapolis, consulting engineers.

Pine River plans improvements in municipal electric power plant, including engine-generator unit. G M Orr & Co, Baker Arcade Bldg, Minneapolis, consulting engineers.

MISSISSIPPI——Waveland plans municipal natural-gas pipeline system, with main welded-steel pipeline to Bay St. Louis, for connection with supply source. Control station will be built. Cost about $45,000. Bond issue being arranged. F P Joseph, Glenmora, La., consulting engineer.

MISSOURI——Fulton recently awarded contracts for improvements at municipal light and power plant as follows: 1500-kw

HERCULES
Seamless Copper
FLOATS



GUARANTEED
TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process, Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

They Hold

For foundations and all moving parts on Diesels, Reciprocating Engines, Pumps, Conveyors, Generators, Stokers or any other equipment subject to vibration, be sure to install

UNSHAKO

The Nuts that can't shake loose

They are the nuts that provide the live action protection . . . a built-in locking ring is always on guard to grip the bolt or stud whenever a backing off tendency occurs. "Unshako" Nuts are one piece, easy to install and can be used over and over again.

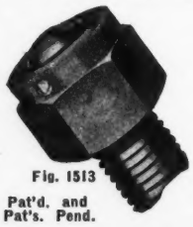


Fig. 1513
Pat'd. and Pat's. Pend.

Send now for complete information

STANDARD PRESSED STEEL CO.

Branches JENKINTOWN, PA. **Branches**
Boston **Chicago**
Detroit BOX 577 **St. Louis**
Indianapolis **San Francisco**

A large shipment of
LIMITORQUE
AUTOMATIC
VALVE CONTROLS
mounted on Crane Valves
for a leading Oil Refinery

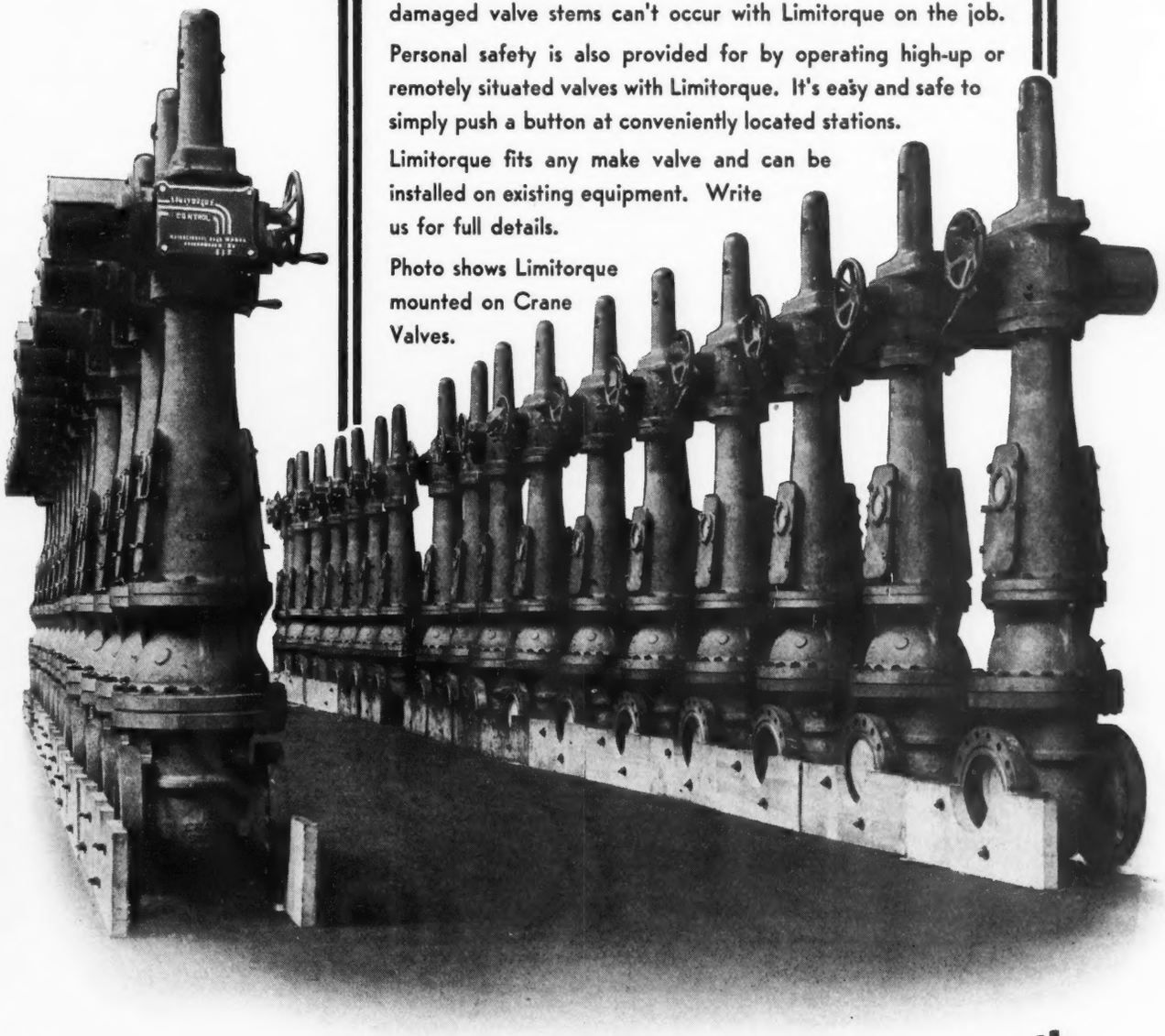
FASTER..SAFER..MORE ACCURATE VALVE OPERATION

Install Limitorque Controls on Globe, Gate, Penstock, rotary plug and many other types of valves where quick, positive valve operation is required. You'll save labor and speed up opening or closing operations far beyond anything possible manually while securing positive assurance against improper seating. Chipped valve gates, bent or damaged valve stems can't occur with Limitorque on the job.

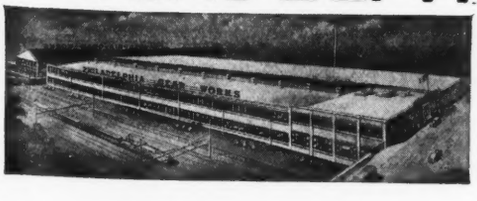
Personal safety is also provided for by operating high-up or remotely situated valves with Limitorque. It's easy and safe to simply push a button at conveniently located stations.

Limitorque fits any make valve and can be installed on existing equipment. Write us for full details.

Photo shows Limitorque mounted on Crane Valves.



PHILADELPHIA *Limitorque*



PHILADELPHIA GEAR WORKS

Limitorque Division

ERIE AVENUE and "G" STREET, PHILADELPHIA, PA.

ADVERTISING PAGES REMOVED

Check these 6 Nek-Seal* advantages with your own packing requirements:

• **NON-SCORING**—Sea-Ro Nek-Seal Packing offers you guaranteed protection against scored rods on high pressure installations.

• **ANTI-FRICTIONAL**—Sea-Ro Nek-Seal is manufactured entirely from non-friction, self-lubricating materials. It forms a smooth bearing surface ending power loss due to packing drag.

• **POSITIVE SEALING**—Nek-Seal's patented construction seals stuffing boxes *permanently*. Your leakage problems are over when you use Nek-Seal.

• **ECONOMY**—Nek-Seal minimizes shut-downs due to regular packing replacements or packing failure. Its first cost is a fraction of the expense of renewing scored, pitted or worn rods.

• **LONG LIFE**—Nek-Seal need never be removed from the stuffing box. It will not vulcanize or carbonize at high temperatures and pressures.

• **EASY HANDLING**—Nek-Seal is flexible, quickly installed and requires almost no maintenance.

Add up all these practical benefits and you will agree that "This Packing Has Everything." So why not get all the facts about Nek-Seal. An inquiry will bring you complete information without obligation.

*Reg. U. S. Pat. Off.

Sea-Ro Packing Company
75 West Street, New York, N.Y.

SEA-RO

turbine-generator to Westinghouse Electric & Manufacturing Co, cooling tower to Lillie Hoffman Cooling Towers, and condenser to Elliott Co. Baumes Engineering Co, Railway Exchange Bldg, St. Louis, consulting engineers.

Macon has awarded contracts for improvements at municipal light and power plant, subject to final approval by PWA, as follows: turbine-generator to Westinghouse Electric & Manufacturing Co, at $39,200; condenser to Elliott Co, at $13,410; boiler and brickwork to Union Iron Works, Erie, Pa., at $20,777, and stoker to Riley Stoker Corp, Worcester, Mass., at $5446. Baumes Engineering Co, Railway Exchange Bldg, St. Louis, consulting engineer.

NEBRASKA —— Alliance contracted Stearns-Rogers Mfg Co, Denver, Colo. for addition to municipal power plant, 1-, 2-, 3-story and basement, 73 x 115 ft, and will install equipment for increased capacity. Cost reported over $150,000. Black & Veatch, 4706 Broadway, Kansas City, Mo, consulting engineers.

Fremont recently awarded contract to Graybar Electric Company, at $2,686, for motor-starting and control equipment for pumping station at municipal water works.

Grand Island contracted Geer Co, 317 North Kimball Ave, for addition to municipal electric power plant. Awards for equipment will be made separately. Black & Veatch, 4706 Broadway, Kansas City, Mo. consulting engineers.

David City will award contracts soon for improvements in municipal power plant, including boiler and accessories, superheater, stoker, feedwater regulator, soot blowers and other equipment. C Robert Fulton, 2327 South 19th St, Lincoln, consulting engineer. Cost about $36,400.

Harry Lambert, Verdel, operating local light and power system, plans early rebuilding of generating station, recently destroyed by fire, with new engine-generator unit.

NEW HAMPSHIRE——Concord Electric Co will extend power lines to London on authorization from New Hampshire Public Service Commission.

White Mountain Power Co, filed new power rates and created new rate structure which it is estimated will save $15,000 to $20,000.

NEW YORK——Eastman Kodak Co, Kodak Park, Rochester, plans 7-story addition to film-processing division. Cost over $500,000. Company also will proceed with additions to camera works to cost close to $750,000. Work scheduled for completion this year.

Bd of Education, City Hall, Buffalo, plans central-heating plant in 3-story school No. 18. Cost about $550,000. Architectural Dept in charge.

NORTH CAROLINA——High Point has low bid from Allis-Chalmers Mfg Co, at $292,100 for three generating units for municipal hydroelectric plant, and is scheduled to award soon. Low bid submitted by Maxton Construction Co, Inc, New Boston, Ill., at $1,674,423 for construction of power dam, power house, spillway, penstocks and other structures, and award will be made at early date. City recently secured license from Federal Power Commission, Washington, D. C., to build hydroelectric station on Yadkin River, with initial capacity of 30,000-hp. Three generating units noted will be of 7000-kw rating each. Estimated cost of project is $6,492,000. Financing has been arranged through Federal aid. Murray & Flood, Inc, 369 Lexington Ave, New York, N. Y., consulting engineers.

Chatham Mfg Co, Winston-Salem, plans addition to woolen mill at Elkin, where production will be concentrated. Cost about $500,000.

NORTH DAKOTA —— Floyd Monteith, Cando, has plans for 1-story cold-storage and refrigerating plant, with locker system. Cost about $30,000. Work will begin soon.

OHIO——Ohio Wax Paper Co, 780 Frebis Ave, Columbus, Edward Palmer, president, plans addition to paper-processing plant for production of waxed and other papers, 1-story, 70 x 240 ft. Cost close to $250,000.

State Dept of Welfare, State House, Columbus, will take bids soon for improvements in power house for state institution at Hawthornden Station, near Macedonia, with new engine-generator unit, boilers, stokers, and coal-handling machinery. Cost about $85,000. J P Schooley, State Office Bldg, Columbus, state architect; R J Ingleson, 229 South Front St, Columbus, consulting engineer.

City Ice & Fuel Co, 6611 Euclid Ave, Cleveland, has leased 1- and 2-story building, 140 x 360 ft, to be built by City of Kansas City, Kan., in Public Levee District, and will equip for new branch cold-storage and refrigerating plant. Cost about $600,000. J W Radotinsky, Commercial National Bank, Kansas City, architect; Walter F Schulz, Shrine Bldg, Memphis, Tenn., engineer.

Cincinnati Metropolitan Housing Authority, 104 West 4th St, Cincinnati, plans central-heating plant in new multi-story housing development on Laurel St. To cost about $1,290,000. Financing arranged through Federal aid. To begin work this spring.

Bd of Directors, Baldwin-Wallace College, Berea, plans improvements in power house at institution, including boilers and other equipment. Additions will also be made to steam-distributing lines. Bids will be asked soon. Wilbur Watson & Associates, 4614 Prospect Ave, Cleveland, consulting engineers.

Union Service Co, Columbus, plans 1-story cold-storage and refrigerating plant at Bowling Green, Ohio. Cost reported at $35,000.

OREGON——C W Laughlin & Sons, 696 Duane St, Astoria, plan improvements in cold-storage and refrigerating plant, including additional equipment.

PENNSYLVANIA——Chief, Division of Purchase, Sales and Traffic, Room 1870, South Bldg, U. S. Dept of Agriculture, Washington, D. C., will receive bids until May 19 for Eastern Regional Laboratory and service units at Wyndmoor, Springfield Township, including boilers, bunkers, pumping machinery, motors and miscellaneous equipment.

Hershey Creamery Co, Harrisburg, plans ice and refrigerating plant in 1-story branch ice-cream plant for storage and distribution at Altoona, where site has been secured. Cost estimated about $50,000.

SOUTH CAROLINA —— Greenwood County Finance Committee, Greenwood, has low bid at $179,711 from Westinghouse Electric & Mfg Co, for turbine-generator unit, switchgear and station equipment for standby power plant in connection with Buzzard Roost hydroelectric power development, and will make award soon.

Abbeville will award contracts soon for hydraulic turbines, governors, and electric generators for municipal hydroelectric plant. Also for dam, power house, penstocks and other operating structures. Fund of $435,000 has been secured through Federal aid. Wiedeman & Singleton, Candler Bldg, Atlanta, Ga., consulting engineers.

TEXAS——Lower Colorado River Authority, Littlefield Bldg, Austin, will contract soon for hydraulic turbines, governors, and electric generators for new hydroelectric station at Marshall Ford dam.

New England Mutual Life Insurance Co, Shell Bldg, Houston, plans installation of air-conditioning plant and system in multi-story office building. Weil & Moses, 457 South Peters St, New Orleans, La., engineers.

City Council, Dallas, plans central-heating plant in new municipal auditorium and music hall, designed to accommodate 12,500 persons. Cost about $1,800,000. Bids will be asked soon. Financing arranged through Federal aid. LaRoche & Dahl, Insurance Bldg, architects.

Humble Oil & Refining Co, Humble Bldg, Houston, plans 4-in. welded-steel pipeline from Woodson oilfield area, Throckmorton County, to connect with main pumping station near Albany, about 25 miles for crude-oil transmission. Cost over $100,000, with booster pumps.

El Paso Natural Gas Co, El Paso, approved plans for immediate construction of new welded-steel pipeline from connection with present system in New Mexico to Duncan, Safford, Miami and Globe, Ariz., for natural-gas transmission, totaling 190 miles. Distribution systems will be installed in different communities, with control stations. Cost reported over $1,000,000.

VERMONT——Barre will acquire municipal power plant. Approval has been given by Vermont House of Representatives.

Celanese Corp of America, Inc, 180 Madison Ave, New York, N. Y., contracted Hughes-Foulkrod Co, Schaff Bldg, Philadelphia, Pa., for new rayon mill and power house at Pearisburg. Equipment awards will be made separately. Entire project will cost about $5,000,000 and is scheduled for completion in 1940.